DOCUMENT RESUME

ED 316 979 EC 230 035

AUTHOR	Harkins, Judith E., Ed.; Virvan, Barbara M., Ed.
TITLE	Speech to Text: Today and Tomorrow. Proceedings of a Conference at Gallaudet University (Washington, D.C., September, 1988). GRI Monograh Series B, No. 2.
INSTITUTION	Gallaudet Research Inst., Washington, DC.
SPONS AGENCY	National Inst. on Disability and Rehabilitation Research (ED/OSERS), Washington, DC.
PUB DATE	Jul 89
GRANT	G0086C3522
NOTE	236p.
AVAILABLE FROM	Scientific Communications Program, Gallaudet Research Institute, 800 Florida Ave., N.E., Washington, DC 20002 ($15.00).
PUB TYPE	Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141)
EDRS PRICE	MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Assistive Devices (for Disabled); *Captions; *Communication Aids (for Disabled); Computers; *Deafness; Demonstration Programs; Electronic Equipment; Microcomputers; Telecommunications; *Telephone Communications Systems
IDENTIFIERS	*Automatic Speech Recognition; Real Time Captioning; Telecommunication Devices for the Deaf; Telephone Relay Services

ABSTRACT

The conference proceedings contains 23 papers on telephone relay service, real-time captioning, and automatic speech recognition, and a glossary. The keynote address, by Representative Major R. Owens, examines current issues in federal legislation. Other papers have the following titles and authors: "Telephone Relay Service: Rationale and Overview" (Paul Taylor); "Overview of State-Regulated Relay Services" (Sheila Conlon-Mentkowski); "TDD Relay Services Across the United States" (David Baquis); "Recent Federal Activity Regarding Relay Service" (Karen Strauss); "The Process of Establishing State-Mandated Relay Services" (Michael Hurst); "Dual Party Relay Service: An Analysis of Funding Mechanisms" (Pamela Ransom); "California Relay Service" (Phyllis Shapiro); "Relay Service for Text Telephone Customers in Sweden" (Borje Nilsson); "Opening a World of Communications for Deaf People: Relay Service in Canada" (Robert Tolensky); "Nationwide TDD Relay Standards: Partners in Progess" (Paul Singleton); "Planning for Statewide Relay Services" (Joseph Heil, Jr.); "Captioning for Deaf People: An Historical Overview" (Malcolm Norwood); "Real-Time Captioning: The Current Technology" (Jeff Hutchins); "Real-Time Captioning: Training and Employment" (William Oliver); "Captioning as an Interpretive Medium" (William Cutler); "Real-Time Captioning in Education" (E. Ross Stuckless); "Automatic Speech Recognition: The Basics" (James Glenn); "Applying ASR to Communication between Deaf and Hearing People" (Judith Harkins); "Applications of Speech Recognition Technology in Rehabilitation" (Jared Bernstein); and "Automatic Speech Recognition of Impaired Speech" (Gloria Carlson and Jared Bernstein). (DB)

ED316979

MONOGRAPH SERIES • Washington DC • Gallaudet University • Research Institute •

MONOGRAPH SERIES

EC230035

Speech to Text: Today and Tomorrow

Proceedings of a Conference at Gallaudet University

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

☑ This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY

Gallaudet
Research Inst

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Edited by Judith L. Harkins
and Barbara M. Virvan
Technology Assessment Program

BEST COPY AVAILABLE

GRI MONOGRAPH SERIES

A Publication of the Gallaudet Research Institute ■ Gallaudet University ■ Washington, D.C. ■ MONOGRAPH SERIES B, NO. 2

Speech to Text: Today and Tomorrow

Proceedings of a Conference at Gallaudet University *September, 1988*

Edited by Judith E. Harkins
and Barbara M. Virvan
Technology Assessment Program

GRI Monograph Series B, No. 2
Gallaudet Research Institute
Gallaudet University

This project received substantial support from the U.S. Department of Education, National Institute on Disability and Rehabilitation Research (Cooperative Agreement No. G0086C3522)

GRI Publication Series and Periodicals

GRI MONOGRAPH SERIES A is a series of peer-reviewed scientific publications (usually single treatises) which includes, among other things, lengthy articles and reports of studies.

GRI MONOGRAPH SERIES B is a series of various types of research-related publications including proceedings, bibliographies, and collections of papers that have undergone external review.

The *GRI WORKING PAPER SERIES* is a series of research publications produced in-house that includes works-in-progress, position papers, and other publications for which timely release is an important consideration.

RESEARCH AT GALLAUDET is a periodical produced three times annually by the GRI that describes current projects, publications, and events at Gallaudet related to research on deafness and deaf people. The publication focuses primarily on GRI activities, but also reports on other research projects and presentations taking place at Gallaudet.

A TRADITION OF DISCOVERY: THE ANNUAL REPORT OF THE GALLAUDET RESEARCH INSTITUTE includes summaries of the GRI's current projects, their respective personnel, collaborators, and funding sources, as well as a report on GRI-sponsored activities and visiting scholars. A portion of the book is devoted to the annual report of the Office of Sponsored Programs, a unit of Graduate Studies and Research which assists campus personnel in seeking extramural funding.

Copyright © July 1989, Gallaudet Research Institute
Gallaudet University, Washington, D.C.

The Gallaudet Research Institute is pleased to disseminate the information and perspectives contained in its Working Paper series. The opinions expressed here are those of the author and do not necessarily reflect the views of the Gallaudet Research Institute or of Gallaudet University.

Persons interested in obtaining additional copies of this document or of the Gallaudet Research Institute periodical Research at Gallaudet may write to:

Scientific Communications Program
Gallaudet Research Institute
Gallaudet University
800 Florida Avenue, N.E.
Washington, D.C. 20002

Cover Photo:
Sheila Conlon-Mentkowski,
NorCal Center for Law and the Deaf

In Memoriam

The Proceedings of *Speech to Text: Today and Tomorrow*

are dedicated to the memory of

Malcolm Norwood, Ph.D.

March 16, 1927 to March 22, 1989

Mac Norwood, a man of great warmth and understanding, was known by many as the "father of closed captioning." He had the vision, dedication, and ability to make closed captioned television a reality, and nurtured its development for the last two decades of his life.

Mac served as an advisor, author, and speaker at the Speech to Text conference. It is with gratitude for his help and for his life's work that we dedicate this volume to him.

TABLE OF CONTENTS

DEDICATION . . . . . page iii

INTRODUCTION . . . . . page 1

ACKNOWLEDGMENTS . . . . . page 3

KEYNOTE ADDRESS . . . . . page 5

TELEPHONE RELAY SERVICE . . . . . page 9

Telephone Relay Service: Rationale and Overview
by Paul Taylor . . . . . page 11
Overview of State-Regulated Relay Services
by Sheila Conlon-Mentkowski . . . . . page 19
TDD Relay Services Across the United States
by David Baquis . . . . . page 25
Recent Federal Activity Regarding Relay Service
by Karen Peltz Strauss . . . . . page 45
The Process of Establishing State-Mandated Relay Services
by Michael Hurst . . . . . page 53
Dual Party Relay Service: An Analysis of Funding Mechanisms
by Pamela Ransom . . . . . page 59
Panel: Financing Models in State Programs
Pamela Ransom, Stuart Brackney, Jack Levesque, and Kathy Woods . . . . . page 73
California Relay Service
by Phyllis Shapiro . . . . . page 85
Relay Service for Text Telephone Customers in Sweden
by Börje Nilsson . . . . . page 89
Opening a World of Communications for Deaf People: Relay Service in Canada
by Robert Tolensky . . . . . page 101
Nationwide TDD Relay Standards: Partners in Progress
by Paul Singleton . . . . . page 107
Panel: Relay Service Operations
Phyllis Shapiro, Börje Nilsson, Robert Tolensky, and Esther Schaeffer . . . . . page 111
Planning for Statewide Relay Service
by Joseph B. Heil, Jr. . . . . . page 119
More Questions and Answers on Telephone Relay Service . . . . . page 127

Speech to Text: Today and Tomorrow

Real-Time Captioning . . . . . page 131

Captioning for Deaf People: An Historical Overview
by Malcolm Norwood . . . . . page 133
Real-Time Captioning: The Current Technology
by Jeff Hutchins . . . . . page 139
Real-Time Captioning: Training and Employment
by William Oliver . . . . . page 143
Captioning as an Interpretive Medium
by William Cutler . . . . . page 149
Presentation: Real-Time Captioning in Education
by E. Ross Stuckless . . . . . page 153
More Questions and Answers on Real-Time Captioning . . . . . page 157

Automatic Speech Recognition . . . . . page 161

Automatic Speech Recognition: The Basics
by James Glenn . . . . . page 163
Presentation: Applying ASR to Communication between Deaf and Hearing People
by Judith E. Harkins . . . . . page 175
Applications of Speech Recognition Technology in Rehabilitation
by Jared Bernstein . . . . . page 181
Automatic Speech Recognition of Impaired Speech
by Gloria Stevens Carlson and Jared Bernstein . . . . . page 189
More Questions and Answers on Automatic Speech Recognition . . . . . page 193

Glossary . . . . . page 195

Conference Speaker List . . . . . page 201

Conference Exhibitor List . . . . . page 205

Conference Participant List . . . . . page 207

INTRODUCTION

Judith E. Harkins[*]

It is with great pleasure that the Technology Assessment Program (TAP) of the Gallaudet Research Institute presents the Proceedings of the conference, "Speech to Text: Today and Tomorrow." This four-day conference, the first of its kind, was held on the campus of Gallaudet University September 27-30, 1988.

The conference was conducted as part of a larger, two-year project funded by the National Institute on Disability and Rehabilitation Research of the U.S. Department of Education. In that project, the TAP explored consumer opinion, policy issues, and business issues related to devices that make use of senses other than hearing. The project's focus was on devices used in daily living by deaf and hard of hearing adults.

When consulting with deaf and hard of hearing consumers on needs for new technology, the desire for an automatic printout of the spoken word was raised again and again, in numerous and sometimes fanciful applications, by people all over the country. Speech recognition technology has clearly captured the imaginations of deaf and hard of hearing people. It was also clear that the current burning issues in the deaf community included telephone relay service and captioned television. These technologies, near-term attempts to fill the need that computers at present cannot, have become central to the lives of thousands of hearing impaired people who have access to them.

These three technologies--telephone relay service, real-time captioning, and automatic speech recognition--share the process of converting speech into text form as a substitute for hearing speech. But the three technologies are developed and implemented in completely separate arenas. An understanding of relay service requires knowledge of the world of telecommunications, regulatory bodies, state legislation, and the complex process of relaying a call. Captioning involves stenography and special computer systems. Automatic speech recognition technology is completely separate from both of these two areas, involving different companies, scientific centers, and periodical literature. It is no wonder that consumers have a difficult time finding relevant, accurate, and up-to-date information.

Speech to Text: Today and Tomorrow brought together experts to provide current information in areas where timeliness is important and the periodical literature is meager. The aim of this conference was to provide an educational program not only for consumer advocates but also for those outside the realm of hearing impairment who might influence the development of relay service, real-time captioning, and automatic speech recognition. We wanted to provide new and timely information, exhibit the latest products for hearing impaired people, and permit participants to get to know each other. It is our hope that the conference served as a springboard for more and better collaboration among participants.

Conference planning was aided by the advice of nine people who met with the TAP staff at Gallaudet early in 1988 to suggest topics and speakers for the conference. Their names are included in the Acknowledgments section. The success of the conference is due in part to their very helpful participation.

The conference attracted more than 300 people from 37 states and five foreign countries. Represented in the audience were consumer organizations, businesses, government, education, and rehabilitation agencies. More than one quarter of the participants were from businesses. The 30 speakers came from such diverse fields as shorthand reporting, operator services management in the telephone industry, public utility regulation, community service, consumer

[*]Judith E. Harkins, Ph.D., Conference Chairman, Director, Technology Assessment Program, Gallaudet Research Institute

advocacy, law, engineering, computer science, and marketing. Communication at the conference was enhanced by the use of interpreters, real-time captioning, audio loop amplification, and FM amplification. The evaluation forms returned by 166 (54%) of the conference participants showed an overwhelmingly positive opinion of the content and organization of the conference.

The content of the conference reflects the state-of-the-art, with all its positive and negative features. One of the functions of the conference was to highlight problems and gaps in information. It was clear, for example, in the relay service segment that few evaluation studies have been conducted in the area of relay services, that little is known about proper training procedures, and that certain legal and ethical issues remain unresolved. In real-time captioning, the cost of the services is prohibitive for many uses of the technology and, again, evaluation is lacking so that the providers of services might be guided by more information about consumer preference and need.

Relay service was given more time and attention in both the program and the conference Proceedings. This emphasis was chosen because of the topic's timeliness and the dearth of literature on it. Unlike the other two topics, relay service has not been the subject of research in the public domain.

The conference exhibits provided a glimpse of current and near-future products in telecommunications and captioning. The fourteen companies that exhibited were an excellent representation of the state-of-the-art in text-based technologies for hearing impaired consumers.

In addition to the conference papers, the Proceedings include transcripts of the panel discussions and most of the question and answer sessions which followed speakers' presentations. These segments of the Proceedings are made available thanks to the real-time captioning process, which enabled capturing the information on disk. A few of the questions were not decipherable and were excluded. The questioner's name is identified where this information was available.

To assist readers in understanding the content of the Proceedings, a glossary of terms used in telephone relay service, real-time captioning, and automatic speech recognition is included. A list of conference speakers, participants, and exhibitors is also provided at the back of the Proceedings.

ACKNOWLEDGMENTS

The success of the Speech to Text: Today and Tomorrow conference was due in large measure to the efforts of many individuals who gave their time and energy to the project. Carl Jensema chaired the section of the program on real-time captioning and arranged for the captioning services. Barbara Virvan coordinated all aspects of the conference and co-edited the Proceedings. She and Vicki Darnell deserve most of the credit for the smooth operation of the conference. Ellie Korres and Kurt Metz assisted in a hundred ways--from mailing list development to notifying speakers that their time was up.

Our many speakers and authors contributed their knowledge and wrote an excellent set of papers. We are most grateful to Congressman Major Owens for giving a stirring keynote address that set the tone for the conference. Thanks, too, to Gallaudet President I. King Jordan for taking the time out of his busy schedule to give the welcoming remarks.

We deeply appreciate the support of our sponsors:

The National Institute on Disability and Rehabilitation Research, U.S. Department of Education, for a grant making the conference possible. Special thanks are due to our project officer, Dr. Richard Johnson.

AT&T for sponsoring a reception.

Bell Atlantic for sponsoring one day of real-time captioning.

American Data Captioning, Inc. for sponsoring a portion of the real-time captioning.

Xscribe Corporation for its donation in support of real-time captioning.

IBM, Inc. for demonstrating its Tangora speech recognition system.

Kurzweil Applied Intelligence for demonstrating its VoiceWorks system.

Ultratec, Inc. for lending TDDs for participants to use during the conference.

Fellendorf Associates, Inc. for lending FM receiver units.

Sony USA for lending a Sony RGV videoprojector.

Special thanks to our program advisors: Pam Ransom of the Chicago Hearing Society; Paul Taylor of the National Technical Institute for the Deaf; Sheila Conlon-Mentkowski of the NorCal Center for Law and the Deaf; Jeff Hutchins of American Data Captioning, Inc.; Alfred Sonnenstrahl of Telecommunications for the Deaf, Inc.; E. Ross Stuckless of the National Technical Institute for the Deaf; Joseph Heil, private consultant; Paul Singleton of the National Association of the Deaf; and Malcolm Norwood, retired from the U.S. Department of Education.

We also thank the many Gallaudet faculty and staff members who assisted with the conference, especially Michael Karchmer, dean of Graduate Studies and Research. Special thanks to: Fred Brandt, Ed Corbett, Sally Dunn, Sue Ellis, Lolly Gilbert, Peter Goodman, Jeff Grandel, and Leslie Proctor. Sincere thanks also to: David Athey; Mike Baer; Ves Bennett; Yvonne Brinkley; Kevin Cole; Shawn Davies; Robert Davila; Charles Drawdy; John Edmond; Herb Emerson; Mickey Fields; Peter Francis; Gerri Frank; Mal Grossinger; Sue Hotto; Vanessa Isua; Robert C. Johnson; Harriet Kaplan; Brenda Keller; Fred Kendrick; Susan King; Erika Levenhagen; Chuck Mann; Wylie Myers; Mary Ann Pugin; Gail Ries; Gary Robey; Sue Russell; Mary Louise Stansfield; Lou Vinner; Donna Wells; Debbie Wheeler; and Cheryl Wu.

Major R. Owens, The U.S. House of Representatives

KEYNOTE ADDRESS

The Honorable Major Owens[*]

I came here this morning from a breakfast meeting at the Willard Hotel. A summit conference sponsored by *Fortune* magazine is being held, a summit conference on education. Only in America could you go from a summit conference sponsored by *Fortune* magazine with some of the heads of the largest corporations in America, to the site of the revolutionary uprising at Gallaudet University. That kind of fifteen-minute ride is certainly, I think, only possible in America.

The television and radio commentators used to love to refer to Gallaudet and describe Gallaudet University with a chuckle and say, "That's the home of the [football] huddle." The football huddle was invented at Gallaudet, and that was the way they described it before we had the uprising [in March, 1988]. And then all of America listened as students proclaimed that their demands were not negotiable, that they were ready to fail their exams or be expelled in order to have the right to determine their own destiny and to have greater participation by the people who are being served by Gallaudet. After that image was projected, I think Gallaudet became the home of the huddle and the home of the brave!

It's a time when most other American college students seem to be asleep, and in no way are participating in the vital political decisions that determine their destiny. [They don't seem] concerned about what is going on in government and what decisions are being made by people who are in charge of society in general, and education in particular--the people who are making it more difficult to go to college because they have cut off grant programs and have made loan programs more difficult. Those students are asleep. At a time when they all seem asleep, the Gallaudet students have been very much alive and vigilant about matters that concern their own destiny. The price of liberty is eternal vigilance, Thomas Jefferson said. Maybe some of the history scholars will straighten it out: The price of liberty is eternal vigilance; the price of progress is eternal vigilance; the price of progress is continued vigilance; the price of progress is continued citizen participation. You must be involved if you are going to make things happen. That is the first and most important consideration that anybody who wants to promote change or wants to receive justice in our society must be concerned with.

You are at this conference to discuss matters which are very much within reach in terms of the technologies available. It needs to be perfected in some cases, and it needs to be mass-produced in other cases. We could have captioned television. That is no impossibility. We could have it without any great astronomical costs. We could have many kinds of new devices to assist hearing impaired persons. It is all within our reach. We could have TDD relays on a statewide basis, on a national basis. All of these things are possible, and they do not really cost that much in the final analysis.

Our greatest problem, however, is the problem of perception. There are so many Americans--and many of them are legislators, many of them are congressmen--who are, in the final analysis, mean-spirited. There are so many Americans who are short-sighted and do not understand that generosity, with respect to human beings, is a great investment in our society. Generosity, with respect to helping those who need help most, always returns a great dividend. When we help those

[*]The Honorable Major Owens (D-NY), Chairman, Subcommittee on Select Education, Committee on Education and Labor, U.S. House of Representatives

who need extra help, we enable them to produce more for society, to make a contribution that they would not otherwise make. So the return is always worth the investment. There are people who don't understand this.

I am proud of the fact that I am a sponsor of the Americans with Disabilities Act. I think it is a revolutionary Act. It is going to be the Act which carries us the last mile over the mountain top with respect to the rights of Americans with disabilities. It is going to be the Act which brings together all of the other progressive legislation that we have been able to get passed, and build on it. We have a firm foundation. We can be proud of the fact that our legislators, our congressmen in the past, and our presidents have been very generous. We have legislation and we have programs in America unlike any in other countries. We have a lot to be proud of, but building on this is what we are doing with this legislation. We are going beyond compassion. We are going all the way to empowerment.

Empowerment means that you do the most for people when you put them in a position to make their own decisions, when you put them in a position to wrestle through the hard choices of how to take care of themselves. The Americans with Disabilities Act will place the authority and the power of the United States government behind all people with disabilities and, combined with their energy and their own activity, make them the kind of force in our society that will enable them to do the rest.

There are 35 million people with disabilities of one kind or another in America. Thirty-five million people don't have to beg in a democracy. I am here today, I hope you understand, not to talk about the details of the Americans with Disabilities Act, not to talk about the details of what this conference will deal with. You are better prepared to deal with those details--discuss the research, discuss the advances in technology--than I am. I am here to talk about the political environment in which you have to operate to bring to realization all of the things that ought to be and could be in our society, to bring to fruition the national programs with respect to television broadcasting, to bring to fruition manufacturing arrangements which will allow us to have certain devices available at very low costs, to bring to fruition the kind of counseling and technical systems available for all people with disabilities--the deaf among them.

In order to make it happen, we must all understand that beyond technology, beyond being able to be advocates among our own group and make everyone understand the need for one device or another, beyond that which we do so well, I think people with disabilities have learned since I have become the chairman of this committee that you have a good reputation for doing your homework and doing it thoroughly. The report of the Commission on the Education of the Deaf, for example, is one of the best of its kind that I have ever seen. The Commission on the Education of the Deaf report with its recommendations are as thorough, as well worked out, as clear and precise as any set of recommendations by any similar commission that I have seen, and I have seen a lot of reports by commissions. I think the Americans with Disabilities Act reflects the points that were laid out in the report by the Commission on the Education of the Deaf. The Act picks up the recommendations and makes them feasible in terms of law. So the homework has been done very well. We have a piece of legislation which is a superior piece of legislation, very thorough, very well worked out. We have experts behind that, and we have your energy behind that, your activity, and all things are in place to make it happen. All things are there except the political environment must be made ready. We must become vigilant.

I would like to define "politician." I am here as a politician, and I make no apologies about that. I would like to take the gritty part away from the definition, and define politician. A politician is one who is in charge of vigilance, one who guides people and helps them be more vigilant, helps them be participants in a process. We have to understand that in order to overcome the mean-spiritedness of those Americans--those people in the Congress and the Administration--who look at every bill and insist that because we have a deficit we should not take any necessary new step that costs money unless it is in the area of defense. They are saying that the problem with our deficit is the social programs, programs--whether health or education programs--that help people. They are the reasons we have such a great deficit. I won't drag you into that debate at this point. I won't tell you why we have the deficit, but there are people who say this, and in the process of this debate, dismiss every new program or every new step forward, every progressive move as being too costly. So what you have with respect to relay service with telephone communication throughout the nation, what we have in terms of real-time captioning, automatic speech recognition, even the research that has to be completed on that, are people who say it is too costly.

On the one hand, we have unlimited amounts of money to spend when it comes time to promote research for Star Wars--that defense in the heavens which is going to stop rockets from landing on us from some outside power: the Soviet Union. That is not feasible research. It is way, way off in the distance. Many scientists say it is impossible, yet we have a blank check. There are unlimited funds available to promote that kind of research. The people who say that we have a deficit and we can do nothing else in the area of helping with communications for deaf people or programs for disabled people in general, the same people will spend that unlimited amount of money.

We have to understand, and we have to get our minds together and understand that this is not an economic problem when the people say there is not enough money. This is not about mathematics or arithmetic. The problem is the problem of the wrong-thinking. It is a political problem. They don't think it is worth it to spend the money on the communications systems that you need. They don't think it's important, and they never will believe it's important unless the people who benefit from it make them understand that it's important.

Never would they understand, the people who are the Trustees--and God bless them, because I don't think Gallaudet would exist if the Trustees of the people who had been in charge for so many years had not believed what they were doing. Surely, up to a point, they ought to be commended, but it took a revolution at Gallaudet for them to understand that there are some things that are more important. I am sure there were discussions. I am sure there were debates. Without an uprising to make them fully understand by the people who benefitted most, it would have never happened.

What I am saying is in the case of the Americans with Disabilities Act and all the benefits that flow from that, and the kind of money that is needed for all the programs that are needed for a mass-scale communications systems to assist the deaf: It will never happen unless we make it happen. It will never happen unless you understand the political environment. It will never happen unless you understand that there is a momentum in motion now. You have started something. The uprising at Gallaudet--I may be exaggerating when I use the term "uprising," but I deliberately use it. I want you to think of it in those terms and I want history to think of it in those terms. When people talk about Americans with disabilities, they are now talking in terms of "before Gallaudet" and "after Gallaudet." That's the historic landmark. I think it is that important.

In order to drive home our message, we need to think of having started something, having put in motion a process that is gaining momentum; and that momentum continues because not only did we introduce the bill for the Americans with Disabilities Act but we appointed a task force on the empowerment of Americans with disabilities. That task force, headed by Justin Dart, is using the Americans with Disabilities Act as its first line of communication, because that Act is so thorough and comprehensive, so they can go out and talk about bringing together all of the people who have disabilities under one umbrella. What we are doing, starting with Gallaudet and the uprising at Gallaudet and proceeding to the Americans with Disabilities Act, is making a movement. That is what it is: a movement. In the Americans with Disabilities Act, we give good cause for all the people with disabilities to come together. If you don't think it is important, if you think the deaf can go their way and the blind can go their way and those with mental disabilities can go their way and we can achieve those things that matter to each one of the groups individually--if you think that is possible, I am here as a politician to tell you that is **not** possible.

In the America of 1988, you must have what we call a critical mass. I'm sure some of you are physics teachers, and you know what I am talking about and you can explain to the others in more detail. You must have enough people moving fast enough to make an impression on our very fast-moving society. It is hard to have the people who are making decisions focus on one set of goals for one group. You have to make them focus. You must have enough momentum. You must have enough numbers, and 35 million--all of the people with disabilities--is a far better critical mass than separation of one group for the deaf and one group for the blind, etc. Bringing everyone together and having a critical mass, creating a momentum, that's what I am here to talk about.

While in the process of maintaining that vigilance, that continued participation that's necessary, you have become a force to be reckoned with--a movement. Justin Dart and the task force on empowerment are helping to create a movement. Justin often refers to the movement as being parallel to a civil rights movement. I submit to you that the civil rights movement never had 35 million to begin with, and even now there are not 35 million who stand to benefit from the details of the civil rights movement. Thirty-five million is a much broader political base to start with, much larger numbers, and the 35 million Americans with disabilities live throughout the entire United States. There are people with disabilities in

every Congressional district. There are certainly people in every state. There are people with disabilities in every agency and in every walk of life, every church, every denomination--all over there are people with disabilities. They must move to focus and come together.

People with disabilities must understand the necessity of asserting themselves and their point of view in order to make happen the things that you want to see happen in this conference. The things you are going to talk about as being possible are technologically possible and physically possible, but they won't happen until they are made politically possible.

Your job is to make them understand, to make it politically possible. You have a second agenda--every one of you, regardless of what your specialty is or where you come from. Every one of you has a requirement to get involved in this movement of disabilities. You must promote the movement. You must understand that the movement is as much a necessity as anything you have ever done in your life.

If you want to know how far behind we are, let me give you this example. My committee had hearings, and people who were deaf testified at those hearings. Naturally, my staff director and other people on my staff immediately made arrangements to have interpreters there, and we had interpreters there. We had the money in our budget, and our committee is supposed to make decisions about how to spend money legitimately. Any money spent legitimately, we are supposed to sign it, and it goes through. Do you know when we sent the bill for the interpreters through for processing they questioned the legitimacy of having interpreters at the hearing? They said that it was not a legitimate authorized expenditure. It wasn't my committee that questioned it. It was the House of Representatives Administration Committee. They said no. They sent it back. We don't pay for this kind of thing. That is where we are, ladies and gentlemen. It's a Neanderthal setting that we are in. The promoters of the American disabilities bill--people who are very knowledgeable of what is going on in the world--couldn't understand that a simple bill (and it wasn't a lot of money, I assure you) was a legitimate expenditure. We had to write memos, raise our voices, and finally it got paid. That's where we are.

In order to get from here to the point where we will be able to legislate captioning for the Congressional deliberations, a national system where television sets are mandated to be manufactured in a way to allow decoding--all the things you want on a mass basis require Congressional action--we have a lot of hard work to do. That is vigilance. That is participation. That is the making of a movement.

I hope you understand. I hope you understand that all of these things are so very possible. All of them would not only not cost our society anything new. It would be an investment which would pay back our society, but getting our decision makers to understand this is a difficult job. That's the job you will have to do. You have to understand there is a section of the Bible that says that the birds have nests in the trees and the foxes have holes in the ground but the Son of Man has nowhere to lay His head. I have interpreted this as being the son of man. Mankind has dominion over everything, yet cannot organize the resources to take care of their own, to be generous enough to take care of everyone.

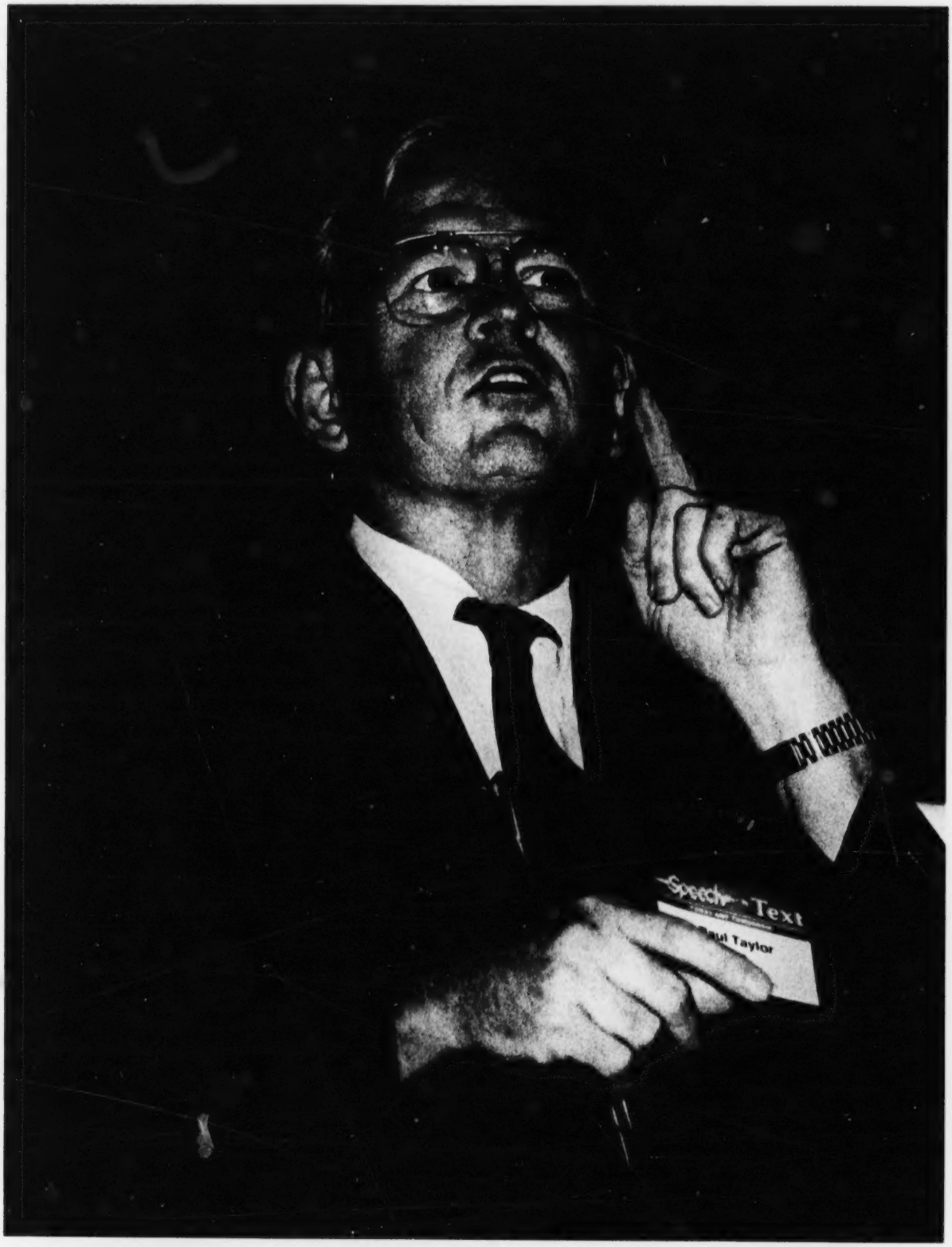
It is a question of organization. It is a question of mind-set. It is a question of morality in all the highest sense, of being concerned. It really doesn't cost anything. It is only the people who are mean-spirited and narrow-minded who insist it costs a lot. They are the ones who have to be shaken loose. You have to hit them and hit them hard to make them understand. Unfortunately, that's the way it is. It is the price of progress. The price of survival is eternal vigilance. The price of survival for us is eternal participation, continued participation. In order to make the things happen that we want to make happen, we must create a movement. Gallaudet has begun. After Gallaudet, let's not go to sleep. Let the movement go forward. Let's pass the Americans with Disabilities Act, and you will find that all other problems will be easily solved after that.

Thank you very much.

Section I

TELEPHONE RELAY SERVICE

Judith E. Harkins, Ph.D.
Session Chair



Paul Taylor, National Technical Institute for the Deaf

TELEPHONE RELAY SERVICE: RATIONALE AND OVERVIEW

*Paul L. Taylor**

What is a Telephone Relay Service?

A telephone relay service provides the best accessibility to the general telephone network for people who are unable to use the telephone due to hearing or speech impairments. The service has as a central point a qualified operator or attendant who "relays" telephone conversations between anyone on the general telephone network and hearing/speech impaired people who use telecommunication devices for the deaf (TDDs). Although the TDDs are connected on the general telephone network via modems, the fact that few hearing individuals have TDDs precludes the hearing impaired users from unassisted telephone conversations with the general public.

The operator or attendant in a telephone relay service has two independent telephone lines. One connects the operator to the hearing/speech impaired person who has a TDD at his or her end; the other one connects the operator to anyone on the voice network. The operator also has a TDD which is compatible with the hearing/speech impaired person's TDD. During the relaying process, the operator speaks on the other line what is read from the TDD and, in turn, the operator types on the TDD spoken words to be read by the hearing/speech impaired person. This near-simultaneous relaying of conversation is, under the present technology, the closest the hearing/speech impaired individual can come to accessing the full telephone network.

Ideally, the ownership and use of TDDs by the general public would obviate the need for telephone relay services. However, it would be most unrealistic to expect 245 million Americans to purchase a $150-$200 electronic TDD just for the sake of calling hearing/speech impaired individuals. Furthermore, only a fraction of the total hearing impaired population possess TDDs. These TDD owners use the TDD mainly to stay in touch with one another and to foster a community kinship which is often referred to as the deaf culture. However, the hearing impaired person's use of TDDs does not generally extend beyond the deaf culture into the working world, where many suffer from underemployment and lack of job opportunities due to the inaccessibility of the general telephone network.

The significant benefits of a telephone relay service are quite obvious. To the hearing/speech impaired person, these benefits transcend mere accessibility to the network. For the first time, users of the relay service sense a new freedom and independence that brings them closer to the "real" world. For example, they can, all by themselves, perform a function that most people take for granted--the simple ordering of a pepperoni and sweet pepper pizza to be delivered to their home. No longer will they need to rely on someone in their immediate vicinity to place the order, and, maybe more importantly, they will not need to explain away such caloric binges!

Rationale for Telephone Relay Services

Without third-party intervention, it is impossible for hearing impaired people to access the regular telephone network. Even though some of these hearing impaired people may have good residual hearing and auditory training in the use of the telephone, the wide

* Paul Taylor, Associate Professor, National Technical Institute for the Deaf, One Lomb Memorial Drive, P.O. Box 9887, Rochester, NY 14623

variation of speech qualities among the millions of people on the network (such as tone, accent, enunciation, inflection, and manner, to name a few) presents formidable obstacles to a clear understanding of conversation taking place over the phone. A telephone relay service renders that third-party intervention as unobtrusively and invisibly as possible. A faceless and nameless operator relaying the call back and forth confirms the hearing impaired caller the confidentiality of the conversation taking place. In addition, the hearing impaired caller need not be concerned with the operator's judgment of the conversation, however candid or private it may be.

Examples of how relay services may help hearing impaired persons are listed below:

- *Relay service increases freedom . . .*

  Calling the racquetball club to reserve a court.

  Ordering a prescription refill at the drugstore so it can be delivered.

  Reserving box office tickets at the theater for an interpreted performance.

  Calling about an ad in the paper.

- *Relay service increases privacy . . .*

  Need some clarification from the IRS on an item on the income tax return form.

  Calling the doctor's office for results on a blood test.

  A concerned deaf parent calls the financial aid office to straighten out his or her child's tuition payment.

- *Relay service increases independence . . .*

  No more asking your son to stop his football playing for a few minutes to make a call for you.

  Secretaries at work are not burdened with making extra calls for deaf workers which adds to the workload.

  Young guys don't have to ask their mother to call a girl for a date.

  A deaf high school teenager can call her hearing friends for help on schoolwork.

- *Relay service increases the desire to succeed . . .*

  A computer operator telephones clients regarding their program status.

  A technician on the road telephones the office to check on availability of parts.

  A self-employed carpenter telephones customers ahead of time to avoid wasted trips to their homes.

  A dentist consults patients without going through the receptionist.

- *Relay service is for hearing people, too . . .*

  Businesses can hound deaf people who have not paid their bills.

  Hearing people don't have to buy a TDD the first day they meet a deaf person they may want to call.

  The funeral director needs to call the deaf brother of the deceased.

  A teacher needs to call her pupil's deaf parent about a classroom behavioral concern.

A study conducted by the Gallaudet Research Institute in 1986 found that people with hearing and speech impairments reported making and receiving only one-fourth to one-third of calls reported as made or received by people with mobility impairments or blindness. Relay service is not a welfare or social service. It is part of the universal service concept of the Telecommunications Act of 1934. A disability is not the same as a handicap. A handicap is created by barriers in the environment that force a disabled person to function differently from others. The telephone used to be a societal barrier to hearing impaired people in California. It is no longer.

Historical Development and Present Availability

The first relay service probably originated around 1966 with the three well-known developers of the

Weitbrecht modem in California. Andrew Saks, James Marsters, and R.H. Weitbrecht arranged for their own relay services in the Bay Area when the number of TDD users was fewer than the fingers on one's hands. At that time, the telecommunication devices were World War II surplus teletypewriters weighing some 60 pounds and not unlike the large and cumbersome early IBM electric typewriter. However, the TDD network grew rapidly immediately afterwards as more surplus machines were donated to the deaf community by Western Union and AT&T.

The first known telephone relay service to serve a core of some 20 deaf families was set up in a private telephone answering and wake-up service in St. Louis, Missouri, in 1969. It was quickly dropped some six months later since neither the answering service nor the deaf consumers had anticipated the prodigious amounts of time required to provide relay services. The consumers could not provide the necessary additional funds to compensate the operators. The relay service was resurrected some three years later when a volunteer organization offered services which, even to this day, have been woefully inadequate in meeting the telephone needs of the hearing impaired population in St. Louis.

Similar stories repeated themselves across the nation during the 1970s. Presently, there are uncounted hundreds of small, volunteer or minimum wage operators positions attempting to answer thousands of relay requests. Most attempted calls are blocked and go unanswered. The result is intense frustration and resignation among the hearing impaired community. Many have given up the idea of using relay services, and simply resort to their friends or family to place telephone calls. Hearing impaired people have found it nearly impossible to make confidential or sensitive phone calls.

Surprisingly, many of the relay service organizations that were set up in the 1970s have managed to struggle and survive to this day. For example, the Hi-Line Relay Service of Rochester, New York, handled 163,497 calls during 1987 with only four operator positions. The blockage rate (percent of callers receiving busy lines) of 30% was quite high. During the earlier years, the blockage rate at the Hi-Line was even higher; many people just gave up on Hi-Line during 1987 and those who called Hi-Line did so out of some measure of desperation. In comparison, the New York State Relay Service, which began operations January 1, 1989, allows a blockage rate of only 1%, which is the same as for operator assistance on the regular telephone network.

The first statewide relay service managed by professionals (in contrast to the numerous volunteer agencies) was implemented in January, 1987, in Woodland Hills, California, to serve all telephone customers in the state. The concept of a professionally run relay service was initiated by the California Association of the Deaf (CAD) in 1983 when it became apparent that surplus funds resulting from a state-mandated TDD distribution program could be used for relay services. CAD successfully lobbied for an amendment to the TDD distribution bill which was passed in 1980. The amendment empowered the Public Utility Commission to solicit bids from telephone companies which may be interested in operating a statewide telephone relay service.

Needless to say, such exciting news spilled over into many states. Due to intensive lobbying by various organizations of deaf people, some 24 states have either established relay services or are currently in the process of legislation. Leading states with operating relay services are Arizona, Washington, Minnesota, New York, Illinois (projected March, 1989), Utah, Oklahoma, Oregon, South Dakota, Virginia, and Alabama (projected April, 1989). Each statewide relay service has its unique organization and funding methods which will be detailed elsewhere.

The California model serves to depict a statewide relay facility size and call volume, as it is the oldest running statewide relay service in the U.S. It started in a single multi-story building with about 135 operators and managerial staff in January, 1987. Its annual budget was set at some $14 million. Today, the facility has nearly doubled the size of its operations staff and has spilled over into a second adjoining building. Its current budget is over $30 million, including additional state appropriations. The additional appropriations were needed because the maximum surcharge the state would allow on each Californian's telephone bill was not sufficient to cover both the relay service operations and the TDD distribution program. It is estimated that each relay call service cost $6 based on more than 200,000 calls currently handled per month. There was no indication as to blockage rate; however, some consumers have indicated that it has increased due to the intense popularity of the relay services. The New York State Relay Service contractor (AT&T), in an attempt to derive operating and budgetary figures from demographic data on hearing impaired persons in New York, used the California call volumes, as they proved more valid for purposes of projecting costs. AT&T simply reduced the figures by about one-quarter to correspond to the respective populations of California (26 million) and New York (18 million).

Organizational Structures

Relay services throughout the United States have demonstrated a remarkable variety of organizational structures. In New York City, there is a blind man who cheerfully provides relay services in his apartment at any hour to anyone who requests it. His remuneration for services is simply the fact that he feels useful in today's society. In Rochester, New York, a housewife with two small children provides a private relay service in her home for some 20 customers for a modest fee; however, her hours are understandably limited and her customers need to plan their calls around those hours. These two relay centers are as basic as services can be.

On a progressively larger scale, relay centers such as St. Louis CONTACT and Rochester Hi-Line provide multi-operator services with limited training programs. They must seek funds each year from various eleemosynary institutions, private donations, and very limited vocational rehabilitation funding.

Next on the scale is the Virginia Relay Service, which recently started to provide relay services as an outgrowth of the National Crisis Center for the Deaf (NCCD). Its projected budget for 1989-1990 is $866,170, which will be derived from many independent sources including some state funding, revenue proposals to city and county governments, contributions from telephone companies, employee donation campaigns, direct mail campaigns, foundation and United Way grants, private donations and endowments, and a dance marathon. The Virginia Relay Service has published brochures to acquaint new consumers and training and operations manuals including a policy on confidentiality. Another example of a similarly organized and funded relay service is Telecommunications Exchange for the Deaf, Inc. (TEDI), which serves residents of Washington, D.C., and adjoining areas in Virginia and Maryland.

Finally, we have the statewide relay services that have been established either by the state legislature or by the state's Public Service/Utility Commission. These centers are large and funded usually in excess of one million dollars per year. The methods of funding these relay services are dictated by the authorizing body and usually do not include the solicitation methods prevalent among the smaller relay services. The statewide relay centers are structured not unlike that of a business which includes, for example, management, operations, training, public relations, accounting, and maintenance staff.

As long as the consumer's various needs are met, economics will dictate the type of organization to provide telephone relay service. And those economic considerations should include factors which are difficult to quantify, such as the price of reliability and long-term stability. The bottom line is full telephone accessibility.

Initiators of Relay Services

Who starts a relay service? Who is behind the political process which eventually leads to the establishment of a relay service? Based on 20 years of constant contact with the telecommunications field, this author is exceedingly proud to say that such origins and constant prodding come from the deaf community. This is a remarkable family which constantly looks for ways to overcome barriers thrust upon them by their inability to hear. Their primary objective is simply to lessen their isolation from the rest of the world and to work for their own support and independence. As an example, the first modem, which made it possible for obsolete yet perfectly serviceable teletypewriters to be linked on the regular telephone network, was built by a profoundly deaf astronomer, Robert H. Weitbrecht, in the early 1960s. His modem was built years before the famous Carterphone court case, which eventually paved the way for direct telephone installation of non-voice equipment. Weitbrecht's modem included a patented anti-echo design which made it possible to send two distinct audible signals only 400 HZ apart. Thus, the Baudot code as generated by these teletypewriters was sent over the regular telephone network as if R2D2 and C3PO were talking to each other in the movie "Star Wars."

In 1983, as a result of intense lobbying by the California Association of the Deaf, the California state legislature agreed to authorize the Public Utility Commission (PUC) to investigate the possibility of establishing a statewide telephone relay system. On January 1, 1987, AT&T, as contracted by the PUC, started the nation's first statewide relay service for all telephone subscribers residing in California.

In an adjoining state, on April 9, 1985, Governor Bruce Babbitt of Arizona signed into law a bill which, in part, would provide for a statewide relay service. In contrast to California, the Arizona Relay Service was contracted to the Arizona Council for the Hearing Impaired (ACHI) by the state, without the direct participation of the state's Public Utility Commission. ACHI then subcontracted for telephone expertise and installations, hired a managerial staff and operators,

and began relay services on March 13, 1988. The ripple effect from California continues through the nearly adjoining state of Washington where a contractor for the relay service is now being sought.

The statewide relay services of California, Arizona, and Washington were created as a result of state legislative action. A novel approach toward the establishment of a statewide relay service without the involvement of the state legislature began in New York in 1984. The New York Public Service Commission (NYPSC) solicited letters from interested parties; the result was an outpouring of support for a statewide relay service. Next, the NYPSC conducted recorded hearings in New York City, Rochester, and Albany in which over 100 people gave testimony for full telephone accessibility. Armed with such testimony, the NYPSC moved under its own authority to create a committee of telephone company representatives, NYPSC staff, and representatives of the hearing impaired community to study the creation, funding, and operation of a statewide telephone relay service. After the committee reported its findings, a formal memorandum authorizing the establishment of a statewide relay service was generated and unanimously approved by the seven commissioners of the NYPSC. The statewide relay service went into operation on January 1, 1989 and is operated by AT&T as the primary contractor along similar organizational lines as that of the California Relay Service.

The initiating of a statewide relay service may require different strategies. Advocates in other states may have initiated the process somewhat differently from that of California, Arizona, Washington, or New York, but the desired end result is similar: the establishment of a statewide telephone relay service to meet the hearing impaired person's need for full telephone accessibility.

Funding Mechanisms

Funding mechanisms adopted by the states that are either planning or implementing relay systems may be classified into the following forms:

Specific tax revenues. Drawing from the tax base a specified amount usually determined by the bill as adopted by the legislature, for all expenses associated with the creation and operation of a statewide telephone relay system. Arizona and Washington employ this means of funding their relay systems.

General tax revenues. State departments dealing with human services (Departments of Vocational Rehabilitation, Commissions for the Deaf, Departments of Social and Health Services, etc.) allocate funds from their budgets to a contractor for the creation and operation of a statewide telephone relay service. The amounts may result from an increase in appropriations or a shift in priorities within the department. Funds may wholly fund the relay system or supplement private sources of income. Connecticut, Texas, Kansas, Massachusetts, South Dakota, Maryland, and Wisconsin are examples.

Surcharges applied to telephone subscribers. This method of funding requires legislative and PUC/PSC intervention and control. Amounts vary from three to ten cents monthly. Revenues derived from the surcharges fund the creation and operation of a relay service and/or the distribution of TDDs among qualified applicants. California, Illinois, Alabama, Oregon, Oklahoma, Rhode Island, Nevada, and Minnesota are examples. Revenues are disbursed to the relay service contractor, which may be a state agency, a telephone company, a nonprofit agency, etc.

As a normal operating expense of the telephone company. New York is the only state that, as of this writing, uses this method of funding. The New York State Telephone Association, which represents all 41 local telephone companies in the state, will draw funds from their normal operating expense budgets according to each company's number of access lines. The opinion of the New York State Public Service Commission is that the relay service is an integral part of telephone service for hearing impaired telephone customers and, hence, must be treated as a utility maintenance item for essential operation of the telephone network. Subsequently, the telephone companies will have every right to request a rate increase from the PSC to cover their increased normal operating expenses. In this manner, they can maintain the stockholder's return on equity.

The funding methods described above are quite diverse. Each state has had to devise a method that is politically acceptable and yet at the same time try to provide a satisfactory relay service that could alleviate the frustrations resulting from lack of full telephone accessibility. Each method has advantages and disadvantages, doubtless, but because of the infancy of

the statewide relay service, further elaboration is difficult.

Whether the telephone relay service is looked upon as an utility component of the telephone or as a social service will ultimately determine its funding. It would be reasonable to assume that over the years into the 1990s funding methods in each state will inevitably change with experience and with lessons learned from other states.

Evaluation Procedures

Developing standards of satisfactory relay service operation against which the contractor of such services may be evaluated is of paramount concern to relay service consumers. Historically, such concerns stem from the fact that over the decades, hearing impaired people have not received satisfactory services from many organizations and agencies. These organizations had every intention of providing services, but were not able to do so due to a lack of feedback mechanisms whereby hearing impaired consumers could provide input and guidance toward the development of services. In short, these organizations were managed by hearing people who assumed knowledge of the needs and problems of hearing impaired people. Experience proved many of these well-meaning people wrong; fortunately, in the last 20 years a significant trend has emerged where more and more hearing impaired people have assumed leadership positions in various organizations and educational institutions. The end result today is a much improved and a more receptive assortment of educational and service programs. It is only fair that representatives of the hearing impaired community be included in defining quality and service standards and to provide feedback on current services. The extent of involvement by hearing impaired people in the design, implementation, funding, and operational aspects of the relay services has been spotty and sporadic. Those relay services operated by human service organizations which are managed in part by hearing impaired people probably are the most receptive to consumer feedback. They have developed detailed standards of service based on years of experience in working with hearing impaired persons. However, in states such as California and New York, where relay services are operated by AT&T, measures to include representatives from the hearing impaired community are being taken. California asked a deaf man to serve on the Deaf Equipment Acquisition Fund (D.E.A.F.), which funds the California Relay Service. The New York State Public Service Commission, in its memorandum establishing the statewide relay service, has stipulated that an advisory board be composed of representatives of the telephone companies and the hearing impaired community. The board is to advise the contractor (now AT&T) on all phases of the relay service design, especially service standards and the establishment of a feedback mechanism. Very little information is known regarding evaluation mechanisms in other states.

Service standards developed in large relay services are quite detailed and will not be mentioned here. A sampling of the most significant items, according to comments from many consumers are:

- Twenty-four hours a day, seven days a week service.
- Acceptable typing speed and spelling ability.
- Identification of operators by number rather than name.
- No judgments in relaying calls except when the operator himself is threatened or abused.
- Reasonable ability to read American Sign Language as presented in text.
- Very low blockage rate.
- Strict adherence to a confidentiality policy.
- Operators inform the consumer of phone status such as dial tone, ringing, etc. rather than maintain a long period of silence.
- No limit on number or length of calls.
- Charges based only on point-to-point distance.

Intrastate versus Interstate Relay Services

Ironically, the subject of intrastate versus interstate relay services surfaced when the California Relay Service began operations in 1987. During all those years leading up to the start-up date, placing long-distance calls was never a problem with the small, privately operated relay services. Calls were billed to the originator's phone number. Since the Public Utility Commission of California could not determine a billing

system for out-of-state calls, the statewide relay service has been strictly limited to intrastate calls. The billing system involving interstate carriers is a complex arrangement which is regulated by the Federal Communications Commission (FCC).

The New York statewide relay service provides limited interstate call services. Calls must originate from New York. The problem of interstate calls exists only where the PUC/PSC of any state has the responsibility of providing the statewide relay services. Other statewide relay services which are operated by agencies with monies derived from tax revenues (as opposed to surcharges or telephone operating expenses) are able to provide interstate services, as the calls are billed to the originator or the recipient on a collect basis.

The FCC recently issued a Notice of Inquiry soliciting comments on interstate relay services. After its deadline of June 25, 1988, some 500 pages of comments were made available for public review. Thirteen organizations representing hearing impaired persons and telephone companies responded in strong affirmative tones that the capability for relay services to make interstate calls is crucial for full telephone accessibility among hearing impaired people. However, differences of opinion were evident on methods of operation and funding. A Further Notice of Inquiry (FNOI), which had a deadline of August 26, 1988, allowed the public to respond to the comments submitted in June, 1988. Hopefully, the FCC will take action toward the establishment of an interstate capability in making relay service calls.

Legislation Pending in Congress

During 1987 and 1988, the National Law Center for the Deaf led a committee of telephone company and hearing impaired representatives to draft a bill for Senator Tom Harkin of Iowa. Chief concerns of the draft bill were performance standards and consumer representation on the FCC review board which would oversee the operation of a national telephone relay service. Pressures resulting from the proposed bill have produced a Notice of Inquiry from the FCC soliciting comments on interstate relay services. The chief aim of the bill, the prodding of the FCC into action, apparently was achieved. (The bill was not introduced.)

In the same spirit of advocacy, Senator John McCain of Arizona introduced S. 2221, which would provide for a relay service for access to the federal government. An amendment was added to this bill to require the FCC to issue a report on interstate relay services 120 days after passage. Hearings on the bill were held on Capitol Hill last June with Senator Daniel Inouye presiding. A companion version of the bill, H.R. 4992, has been introduced by Congressman Steve Gunderson, with Congressman Major Owens as one of the co-sponsors.[1]

The Future of Telephone Relay Service

Despite the wide diversity of telephone relay service funding and organizational methods, the future for effective relay services appears very bright, indeed. Perhaps the best indicators could be found in the sheer volume and support of the written comments submitted to the FCC last June. Nearly all comments supported the idea of a relay service as a means of achieving full telephone accessibility for hearing impaired people. It is only a matter of time before all 50 states will have adequate relay services, and full interstate relay services will be a reality for everyone.

No one knows for certain how policy will develop, but here are some predictions: Organizational and funding methods for each intrastate relay service will remain dissimilar for a long time. Interstate relay services most likely will be provided by inter-LATA or interstate carriers through a contractor; some means will be found to devise applicable billing methods whereby each state's PSC/PUC would collect from the interstate carriers. Approved interstate rate increases will provide for such funds. The increases will be devised in such a manner that no interstate carrier shall be placed at a competitive disadvantage.

The comments given to the FCC indicated much support for feedback mechanisms where representatives of the hearing impaired communities can have a large part in the evaluation and proper operation of relay services. The political process in setting up relay services will certainly provide for such feedback mechanisms. Existing services will strengthen and increase affirmative action in the hiring of qualified hearing impaired applicants for managerial or non-operator positions.

New methods in relay service appear technically feasible. For example, it should be possible for the caller to dial the intended number rather than the relay service number to free the operator from dialing and thus help shorten the length of time of service. This could happen with special coding in the first four digits of a typical eleven-digit number. A "half relay service" should be possible for hearing impaired people with excellent speech; they could speak over the phone and

the operator would only type the responses. A means would be devised so that relay services can be requested by gender so that in business and professional calls, the operator's voice would approximate that of the hearing impaired caller. A simple emergency phone number would be provided in place of 911 to alleviate hearing impaired people's concerns in placing an emergency call.

The impact of the burgeoning relay services will have a profound effect on educational systems for hearing impaired persons. Classes in typing and phone etiquette will be offered to children as early as their motor skills will allow. Increased use of the typed word will improve their linguistic skills. In the upper grades, classes on using the phone in job-related environments will be offered as a means of removing telephone barriers that preclude many job opportunities. Deafened adults will have evening classes to learn how to use TDDs in conjunction with the relay services so that they can maintain their former use of the telephone.

The question as to whether a relay service is basically a socially-oriented service or an essential component of the telephone will remain with many people for some time. If these people can view a disability differently from a handicap, relay service should be considered as part of the universal service concept of the Telecommunications Act of 1934. This kind of view may create an attitude which could lead to the consideration of relay services as a component of the telephone, and lastly, as a public utility that will remain with us regardless of our ever-changing economic or political climates.

QUESTION AND ANSWER

Question: Would you comment on the pros and cons of having the relay service offered through a human service agency versus a utility?

Answer: ***The "pro" of a utility concept is that the telephone relay is looked at as part of the telephone system itself. Therefore, under the utility–like electricity, water, gas, sewer, and so forth–you know that those services will always be there and will remain. You don't have to worry about any changes in funding from year to year. The "con" is that often agencies running the relay as a utility concept are large and they're very insensitive to deaf people's needs. But I think that with proper communication and proper consumer participation through a board, and proper training and evaluation, [utility agencies] can meet the needs of deaf people. As I said, it's very important that consumer participation be included anywhere and at any time you set up a relay service.***

Notes

1. Since the conference, these bills were passed. The resulting P.L. 100-542 is called the Telecommunications Accessibility Enhancement Act.

OVERVIEW OF STATE-REGULATED RELAY SERVICES

Sheila Conlon-Mentkowski[*]

From the time the American telephone system was established until the introduction of the teletypewriter (TTY) in the 1960s, deaf people were separated from the mainstream of American society. The use of TTYs, which allow deaf people direct access to telephone networks, has grown with the production of modern day telecommunication devices for the deaf (TDDs). More and more deaf individuals are acquiring TDDs as the prices lower and more models are produced.

SCPE Distribution

Initially, the various states regulated the distribution of specialized customer premises equipment (SCPE), which is telephone company language for the special devices hearing impaired people in this country need to directly and effectively use the telephone network. The state administrative agencies responsible for this regulation are called Public Utility Commissions (PUCs), Public Service Commissions (PSCs), or State Corporation Commissions (in Virginia, VCC). The PUCs have the authority given them by state law to oversee utility providers, such as gas, electric, telephone, and water companies, to ensure that they serve their customers fairly and reasonably. The utility companies must petition the state PSCs if they wish to change their rates or initiate any other significant changes in their services to customers. The state PSCs have the power to review these petitions and decide if they comply with state law. Hearings can be held, and the public is notified of these hearings either through an insert in their utility bills or notices in their community newspapers. The public may be allowed to testify during these hearings and give the PSC input on their views of the requested change.

The most commonly offered telecommunications benefits or services provided to deaf and hard of hearing subscribers prior to the widespread advent of state-regulated relay services was typically state distribution of SCPE, such as TDDs for certified deaf residents of that state, and reduced intrastate TDD rates. The distribution programs varied from state to state, but basically a deaf subscriber had to obtain certification from a designated official that he or she could not use a telephone without a TDD. He or she then could obtain a TDD from either the telephone company or state office responsible for administering the TDD distribution program. Some states had income qualifications and other restrictions before an individual could qualify to receive a TDD; others merely required proof of hearing impairment and state residency. In order to obtain these distribution programs and statewide relays, the deaf community had to petition either its PUC or legislature.

Nonprofit Volunteer Relay Services

With the expansion of state TDD/SCPE programs since 1979, there came a realization of the need for what was then called an "answering service" or TDD telephone relay. Deaf TDD users were limited to "talking" to other TDD users and would still have to go to hearing family members or co-workers to make voice telephone calls. These early telephone relays were usually operated by volunteers or nonprofit

[*] Sheila Conlon-Mentkowski, J.D., Director, NorCal Center for Law and the Deaf, 2045 Hallmark Drive, Suite 4, Sacramento, CA 95825, (formerly with the National Center for Law and the Deaf at Gallaudet University)

organizations. There are still about 225 nonprofit or volunteer relays throughout the U.S.

These nonprofit or volunteer relays are useful and do help the deaf community in gaining direct access to the telephone network. However, a growing dissatisfaction with these volunteer relays occurred with the deaf community's expanded access to, and use of, the telephone network. There are a variety of reasons for this. Since the relays relied on volunteers, there was usually a limited number of hours available to use the relay, i.e., from 7 a.m. to 11 p.m., with the hours between 11 p.m. and 7 a.m. reserved exclusively for life or death emergencies. I once tried using a nonprofit relay at 11 p.m. in order to request a ride to work from a hearing co-worker, as I had to drop my car off the next morning for repair work. The garage opened at 7 a.m. and if my car was to be worked on that day, I had to get it in by 7 o'clock. It was obvious that I would have great difficulty calling a hearing co-worker at any other time through the relay. The relay operator told me to get off the line, as this was not considered a true emergency within that relay's definition of the term. I disagreed, but since the relay was a nonprofit organization and wasn't regulated by the state, I could not lodge a complaint.

Another problem with the nonprofit relays has been restrictions on the length of use, usually fifteen minutes per call. Most deaf users sometimes do not feel comfortable with volunteers running the relays because volunteer training can be uneven, leading to frustration for the caller. Another concern is confidentiality. Almost all of the nonprofit relays assure relay users of a code of ethics regarding confidentiality, but because these relays are not regulated by the state and therefore not bound by state law, relay users do not feel secure about the confidentiality issue. One other problem frequently encountered with these volunteer relays is the constantly busy lines when users attempt to dial them.

Partly as a result of these frustrations and also as a result of the growing desire for equal access to the telephone network, statewide regulated relays came into existence. At least 22 states are presently in the process of studying, establishing, or already have established statewide publicly mandated TDD relay services. Some of the states have decided to regulate their relays either through their PUC or another state agency, depending on how the funding for the relay is obtained. Some states have required that funding for the publicly mandated relay come from the telephone companies. This method of funding can vary from a per line telephone surcharge to an excise tax on subscribers' telephone lines; other states have allowed the telephone companies to come up with the funding from the telephone companies' operating funds.

A few states, such as Massachusetts and Maryland, have used other means for funding their publicly mandated relays. Funding comes from general tax revenues or other state funds. The number of established statewide mandated relays still remains small, as others are still in the planning or study stage. These relays are fairly new. For example, California's began in January of 1987 and New York's began in early 1989. The oldest mandated relay program appears to be Connecticut's, which has been in place since 1979.

However, despite a tremendous amount of planning and preparing for these various relays, problems are still encountered with each state relay. Some common problems include insufficient funding due to the unexpectedly high volume of calls handled (as a consequence, a few of the relays have had to scale back their operations). A few have problems with providing interstate access, which means they cannot relay telephone calls across state lines. Another problem encountered by some states currently in the planning process is the perception and apprehension that the federal government will preempt the states' authority to regulate their own statewide relays. This fear seems to be delaying actual implementation of the statewide relays, as state authorities seem to be waiting and delaying in order to see if the federal government will remove the burden of providing this service from the states.

In spite of these problems, the states are recognizing the crucial and valid need for statewide relays. The current relay in California is a good example, as calling volume is presently in excess of 200,000 completed calls per month. The process of establishing and actually operating a statewide relay is time-consuming, but once established is well worth the effort. Customers in states with established statewide relays should communicate any concerns and frustrations with the relay to the agency responsible for overseeing the system. Unless relay users do this, they share the blame for any continuing problems with the relay. If you are a user of the system, then you are paying in some way for it and you should not let your money go to waste.

Since California appears to be the model other states are emulating, I will use it as an example of a state-regulated process. California was able to use the PUC oversight method to implement its relay due to its already established TDD distribution program.

The provision for oversight of the state-mandated relay's budget also varies, depending on state policy. Most will require that either the state-mandated board overseeing the relay or the PUC or state agency assigned to administer the program review the relay budget annually. This is an important part of all the statewide relays, as this review allows for requests for additional funding if deemed necessary. For example, the unexpectedly large use of the California Relay Service led to the state recognizing that additional funding would be necessary since the current surcharge fund collection was insufficient to adequately operate the program.

A few states have had problems using their PSCs as the state oversight agency. Maryland is an example. The Maryland PSC, for unarticulated reasons, was reluctant to become involved in directly overseeing the statewide relay although it recognized the need for such a service during a PSC hearing. The Maryland PSC referred this issue to the state legislature to decide how to administer this program. The Maryland General Assembly decided to delegate the oversight authority to the Maryland Department of Human Resources.

The common characteristics found among the state-regulated relays are as follows. The state has authority to oversee the relay by monitoring it to ensure that it is offering the necessary service. All mandated services usually require input from the deaf community as to how the service is being run, both at the initial development and planning of the relay and during its actual implementation and operation. All the state-mandated relays recognize that the ultimate goal of their relays is to make the telephone network as accessible to the deaf community as it is to the hearing community.

Operation of State-Mandated Relay Services

Most of the relays are for the use of the callers within the state, requiring that the calls originate within their respective states. Some do allow interstate use of their statewide relay systems. The relay operators are typically required to relay all conversations verbatim except when verbal abuse is directed at the relay operator. In such a case, the operator may terminate the call. This is a policy established by the statewide mandated relays and also followed by most volunteer relay services.

In actual use, it is standard for a caller to give the relay operator his or her name and the telephone number being called. Some relays may require the caller's telephone number if the call involves long distance billing, whether intrastate or interstate. Most of the publicly mandated relays are structured so that the bill will be from the caller's number to the number called, not from the caller to the relay. Most of the relays use 800 numbers so that the relay user is not charged for the call to the relay. The operator will usually tell the caller when the phone is ringing or when the line is busy.

Some relays place no limits on the number of calls made at one time. In contrast, the Minnesota policy for its soon-to-be established, if not already operating, relay states: "A calling party can request no more than three different relay calls each time he/she contacts the relay center." But Minnesota policy also states that relayed calls have no time limits placed on them. To my knowledge, all of the state-mandated relays have no time limits placed on calls. Some of the nonprofit relays do. Relay operators are required to handle all calls in a professional and courteous manner.

With respect to the issue of confidentiality, all the established and planned statewide relays require that all completed calls be kept confidential. Any records of actual relayed calls are to be destroyed. Most policies require investigation into the matter if a relay operator breaches this confidentiality requirement; and some require that the operator be fired if the investigation finds a breach of confidentiality.

Regarding emergency calls, most of the states that have mandated relays also require that the 911 numbers within their jurisdictions also have TDD access. These statewide relay operators are trained to instruct TDD relay callers to directly dial 911 numbers themselves. For non-911 emergencies, relay operators are to handle these calls in an efficient and appropriate manner.

The training of relay operators is usually outlined in the state policy. Some of the relays require that the operators type a minimum of 50 to 60 words per minute. They are required to have a basic familiarity with the language of the deaf community, which ranges from American Sign Language (ASL) to standard English. Some require verbatim translation of the typed messages while others require that if the caller so requests, the relayed call may be translated into standard English. Most of the mandated relays have a policy forbidding relay operators from interjecting any opinions or comments during relayed calls. They should also know the abbreviations used in TDD conversations, i.e., GA, SK, PLS, QQQ, etc.

Most of the state-mandated relays will not handle requests for information since their primary purpose is to relay telephone calls and not provide information. Some of the nonprofit relays do handle this type of

call. For example, I did not realize that the Washington, D.C., Automobile Association of America office had a TDD number until the nonprofit relay operator informed me. Calling parties requesting directory assistance will be referred to operator assistance. Parties requesting basic information about the relay will be referred to the relay's administrative office. Some of the relays will not call numbers that provide information such as weather reports and the like.

Billing policies vary, depending on the type of calls placed. California will not handle interstate calls except for 800 toll-free telephone numbers. Relay callers can usually place calls either through collect calls (charged to the called party), credit card, or third-party billing.

Emerging Trends

As noted earlier, with at least 22 states known to be studying or in the process of establishing or having statewide mandated relays, I am confident that the remaining states will follow this trend. However, one concern that crops up repeatedly is about those states, such as Wyoming, Montana, and North Dakota, that have a sparse and widely spread deaf population. Their need is certainly the same as the other states, but funding resources may be limited. Funding appears to be a common problem even in states with established and mandated relay systems. The need for accessible and efficient relay systems is recognized. It is frustrating to watch states go step-by-step through similar processes in order to establish their own statewide relays. Due to the state utility regulation issue, these steps are necessary. This conference and the materials developed from it may help those seeking to establish and/or improve their state relay systems. As a frequent traveller, I hope to see a uniform practice of state relay TDD and voice numbers printed prominently in every public telephone directory or in places where travellers normally look to obtain such numbers.

I am also optimistic that as more relays are established, more TDD distribution programs will be continued and established at the minimum for those who cannot afford this equipment. While I was a member of the Maryland Governor's Commission on the Hearing Impaired, a needs study was submitted to the Commission. It was compiled by a Commission member who worked at a medical center serving inner city deaf patients. That study showed that of 400 deaf patients served by the center, fewer than half had TDDs in their homes. They were too poor to afford them and were also probably too poor to afford residential telephone service. I believe that this situation is not limited to that one city, that in almost all areas of the United States deaf individuals will not have TDDs or telephone service in their homes. A study by the Florida Council of the Hearing Impaired concluded that 94% of households in the U.S. had telephone service. The Florida study found that of the 6% not having telephone service, 98.6% of the estimated population was hearing impaired. As a matter of fact, the California PUC found that once its state-mandated relay was in operation, its state TDD distribution program grew by 12% for the first seven months that relay service was available, nearly doubling its previous annual growth rate. [From the California Public Utility Commission, Evaluation and Compliance Division, Report on Funding Problems Involving Deaf and Disabled Telecommunications Services, 22 (Nov. 13, 1987).]

This California example should encourage other states to either continue or establish TDD distribution and relay programs so as to substantially improve the quality of their deaf citizens' lives.

In conclusion, by the year 2000 it is hoped that all deaf individuals will be able to easily use the telephone network via relay systems or future equally effective technology.

QUESTION AND ANSWER

Question: You mentioned that state dollars are looked at as being synonymous with viewing the relay service as a human service. I don't think that is necessarily so, and I think that those states that are asking legislators to fund a relay service need to present it as a service for the entire population. We are increasing access to a population that has, in the past, not been accessible to the hearing population. This service potentially will help businesses and will ensure hearing people that telephone accessibility will be there should they need it in the future. I'm not trying to downplay the obvious need and benefit to the deaf population but rather I'm trying to convince the hearing population, which is much larger, that it is something that is for everyone. It's not a human service that is funded specifically for hearing impaired and speech impaired persons.

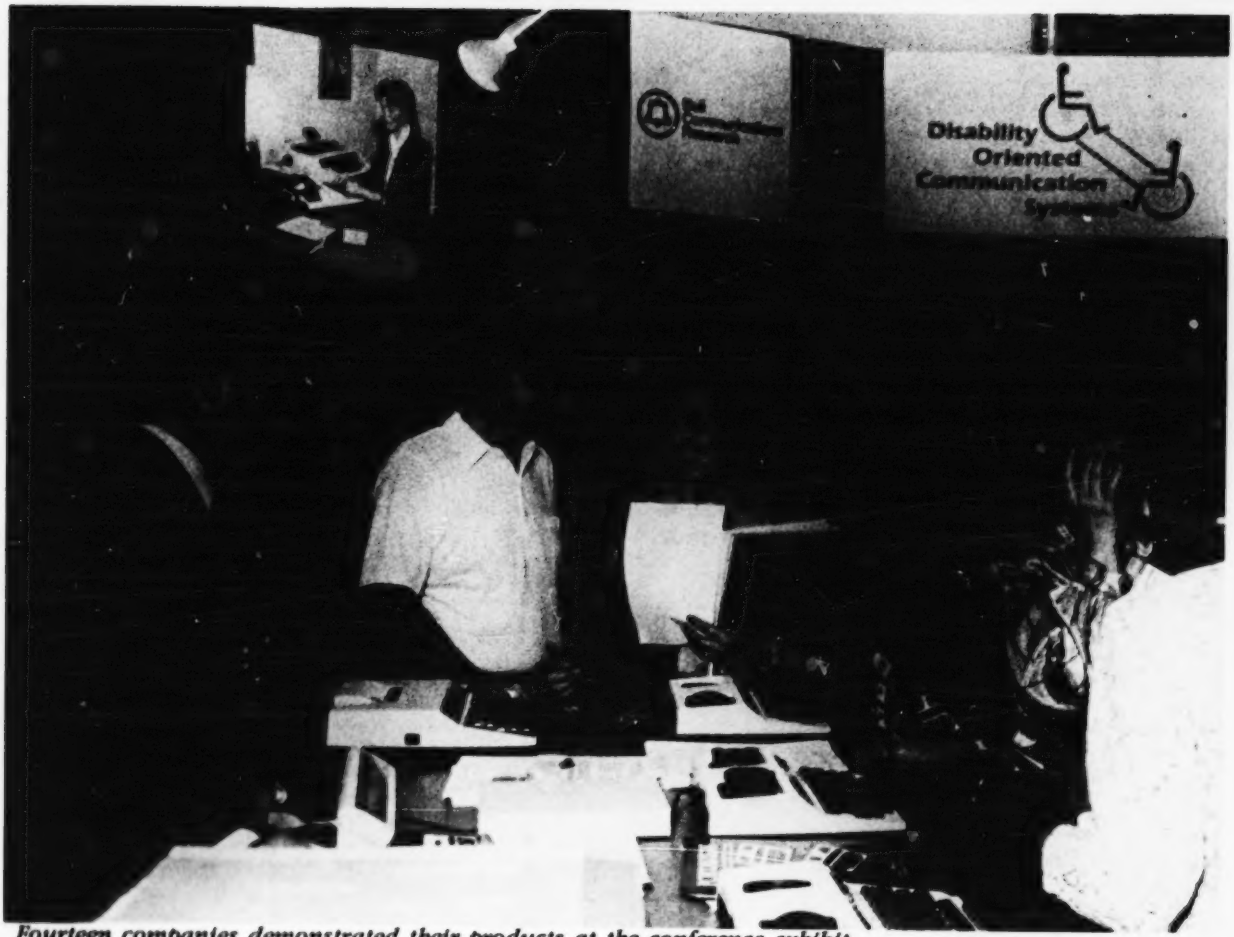
Answer: *You're right. That's true, but I guess my point was that we have a policy issue here. There are many deaf and hearing impaired people who see the telephone as a utility. We want to be able to use it the same way as hearing people use it, so we feel, "Why should my state tax dollars go for that when I'm paying that service through my telephone bill every month?" I think that's what I'm trying to suggest when I say that maybe this state tax money should be used or viewed as a human service component. You see, in my own personal experience with the state of Maryland, we had some problems with trying to come up with funding, and we ended up only getting $169,000 out of the state tax revenue. I'm hoping that once that relay is set up, the amount of funding will become available through other resources because the state tax money from general revenues itself has limitations, too.*

Question: **How do you guarantee that it will be an adequate relay service? I mean, you could set up a system and you might find that the people who want to use it are getting the busy signal all the time. You want the telephone lines to be functional. The deaf should be getting a service comparable or identical to what hearing people are accustomed to. There would have to be some sort of controls built in. What are the states doing to try to ensure standards?**

Answer: *There really are several ways of doing that. One is through the establishment of a board with consumers on it. I believe there are several states that have that or are in the process of developing that. California only has one deaf member on its board. It is a very difficult question to answer because, again, it depends on the individual state and whether or not consumer participation is actively encouraged. But I want to remind all of you, if you have any negative or positive experiences with the relays, especially negative ones, please let the relays know. They won't improve services if you don't let them know. I have used both voluntary and state relays. I just moved from Maryland, and I have used volunteer relays here in this area, and have been very frustrated with busy lines. And to my surprise, when I moved to California, the CRS [California Relay Service] is busy also. I learned that I have to figure out which hours are the peak times. I guess I need to document those times that I call CRS because I was just trying that Sunday night at 8:48 and all of the operators were busy, and that was not a holiday weekend. So I was surprised to encounter that problem. You can see the problem is not always only in one area, but in a variety of areas.*

Correction

Page 22, second column, first paragraph: The Florida Council for the Hearing Impaired surveyed a non-random sample of hearing impaired people, of whom 98.5% did not have TDDs. The paper inaccurately states that 98.6% of those people without telephone service are hearing impaired.



Fourteen companies demonstrated their products at the conference exhibit. Pictured at left is Stan Sikorski of Krown Research, Inc.

TDD Relay Services Across the United States

*David Baquis**

According to the National Center for Health Statistics, there are over 21 million hearing impaired and 2 million speech impaired people in the United States. Some of these people must use a TDD for telephone communication. Since many individuals and businesses are not TDD-accessible, many TDD-dependent users do not have full access to the telephone network. A TDD can only be used to communicate with another TDD or computer. A TDD user who wants to communicate with a non-TDD user requires the assistance of a third party who, acting as a telephone interpreter, relays the call. These relay service personnel communicate with the TDD user (by TDD) and the non-TDD user (by voice).

There has been little accessible information about TDD relay services. The local phone companies are limited in the information they can disseminate about relay services in much the same way as they are limited in the provision of information on long distance telephone services. Even the deaf community has limited information on relay services. Relay services are geographically scattered with different names and phone numbers, different days and hours of operation, and different rules and standards of operation. This situation has created an urgent need for accurate information to ensure that this segment of the population has access to the basic telephone system.

It is especially important that people in key positions, such as legislators, rehabilitation personnel, and telephone company personnel, become aware of the number of available relay services and the differences among them. The Tele-Consumer Hotline has surveyed many relay services across the United States, and this paper provides an overview of these services from a consumer perspective.

First, it may help to understand the function of the Hotline. The Tele-Consumer Hotline is a nonprofit, independent consumer information service established in July, 1984, shortly after the divestiture of AT&T. It was founded to educate consumers about changes in the telecommunications environment. We help answer questions such as how to choose a long distance phone service, how to save money on phone bills, and what to do when your phone doesn't work.

In early 1986, the Hotline implemented a Special Needs Program in response to the lack of information in the special needs equipment market. We found that providing information on available special equipment such as TDDs was not enough. TDD-dependent consumers cannot have universal access to the telephone network without relay services. Thus, the Hotline began collecting information about relay services across the country.

We were not the first organization to undertake such a project. The National Technical Institute for the Deaf surveyed about 90 services in 1984. That project was never completed and the information gathered is now out of date. In 1986, Dane County (Wisconsin) Message Relay Service prepared a packet of comparative information in both a narrative and matrix format. That data was limited, however, to the ten relay services within the state of Wisconsin. The National Center for Law and the Deaf also provides a comprehensive summary of relay services, but the information is limited to those services which are regulated. The Tele-Consumer Hotline has published the results of its research in eight regional *TDD Relay Services Comparison Charts*. The publications are available free of charge. The Hotline is accessible on a toll-free number[1] to both voice and TDD users. The

*David Baquis, Special Needs Manager, Tele-Consumer Hotline, 1910 K Street, N.W., Suite 610, Washington, DC 20006

Hotline's other publications, geared to the special needs community, include a *TDD Directory Listing* and a *Special Needs Fact Sheet*. These and other Hotline publications are described in our brochure (see Appendix 1).

The data in this report are based on the 168 relay services which responded to over 200 questionnaires sent out between early 1987 and the spring of 1988. However, the Hotline has evidence of the existence of well over 300 relay services (see Appendix 2). Surveys were sent only to those services which relay calls from more than one location. Also, there are many TDD-accessible agencies which, although they do not advertise themselves as relay services, may help out occasionally upon request. In other words, many relay services provide telephone relay assistance as a secondary service. Such organizations include libraries, crisis lines, churches, and information centers. The collection of data was challenging. Some services did not respond even after repeated contact via phone and mail. Some reasons may be:

- **Wrong address/defunct service**. There was no single source of information about all relay services. Many organizations such as the Gallaudet Research Institute, the National Center for Law and the Deaf, state vocational rehabilitation departments, state associations for deaf persons, and state Public Utility Commissions helped us locate addresses and phone numbers of relay services. TDD directories were also a good source of information. Some of our leads were taken from old newspaper clippings and magazine articles. Information was even discovered in the locked file cabinets in the basement of the Gallaudet University library.

- **Desire to remain unlisted**. Some services specifically asked to remain unlisted due to a concern about overuse and misuse of their service. For example, one university offering the service only to students feared that non-students would call the service. A few one-person services operating out of private homes indicated a preference to relay calls only for friends or select clients.

- **Insufficient staff**. Some relay services may not have a large enough staff to respond to surveys.

Terminology/Type of Relay Service

The questionnaire was designed to elicit information about twelve service features, such as service territory, population served, accessibility, days and hours of operation, and service limitations. Many services needed to be contacted again by phone to clarify their responses to our questionnaire. Our terminology and that used by the services differed significantly. Several terms were used to describe relay services: message relay service, interpreting relay service, answering service, telephone interpreting service, one-way or two-way relay service, monitoring service, and dual party relay service. Some people were under the misconception that the name of the relay service they were familiar with was the generic term used for all relay services. For example, some people thought all relay services went by the name of Contact or TEDI.

The Hotline's chart distinguishes between two very different types of relay services: message relay and dual party relay services. One very limited type is a "message relay service." It functions much like an answering service by taking a message from its client and then relaying that message at a later time to its client's party. Some message relay services will allow the client to remain on-line while his or her message is being relayed. The message relay service will then inform the client that the message was received and report on the response of his or her party. A back and forth or ongoing conversation between the client and his or her party does *not* take place.

The other type of relay service is "dual party relay service." A back-and-forth or ongoing conversation between the client and his or her party takes place with the help of a relay operator who stays on both phone lines. This service allows both parties immediately to respond to another through a relay operator. Most relay personnel attempt to remain impartial and relay the exact words used by both parties.

The term "message relay" is most commonly used by the TDD services to describe their service, but it can be misleading. A traveller from out of town, for example, may be disappointed when he or she tries an unfamiliar relay service and discovers that the service has only one phone line, thus rendering it incapable of providing a dual party relay service. The term "interpreting relay" confuses some people who think this means that sign language interpreters are available for walk-in clients. The term "answering service" also can be confusing because some services provide a

message relay service and others a dual party relay service.

Forty-two percent of the responding services provide both dual party relay and message relay. Forty-eight percent provide a dual party service only and 11% provide message relay only. Many services prefer to relay calls in the dual party format because they do not want to be responsible for conveying important messages to someone who is difficult to reach.

The terminology for the personnel who staff the relay services also varies. For example, the terms message relay operator, TDD operator, message relay associate, communications assistant, and message transfer specialist were used to refer to the same staff member.

Survey Results

Of the relay services surveyed, 25% had a single telephone number for both voice and TDD users. A phone number listed as both voice and TDD is often answered by voice first. If no one responds to a verbal greeting or if TDD signals are heard, the call is answered by TDD. Since most relay calls are initiated by TDD users, some relay services will answer by TDD first in an attempt to conserve time. Of the relay services responding to our survey, 75% have a separate number for voice and TDD callers. Some services with a separate line dedicated for TDD users may have the TDD connected directly to the telephone jack, which means they may not be able to answer that line by voice. Eight percent of the listed services offer toll-free numbers to clients.

Geographical Region

Most relay services aim to serve the TDD users of a local region, but are willing to receive calls and initiate calls irrespective of location. Only two of the responding services are national, that is they list the entire United States as their service territory. The Federal TDD Relay Exchange helps people throughout the country conduct federal government business. Another national relay service, the Telephone Interpreting Service for the Deaf, will make calls anywhere in the United States and is accessible via a toll-free number.

Population Served

Fewer than 1% of services responding to our survey restrict service to a limited population. Examples of population limitations are university students only or adults only.

Days/Hours of Operation

Many relay services indicate that they would like to be available 24 hours a day, seven days a week, but only 40% of those relay services responding reported this continual availability. Most services relay only emergency calls during non-business hours.

Fees

Most relay services are available free of charge. This is due, in part, to the utilization of volunteer staffers. Only 1% of the services responding require that clients first subscribe and establish an account. It would be interesting to learn if the services requiring pre-subscription have better quality--specifically, easy accessibility and efficient relaying.

Accessibility

Most consumer complaints revolve around poor accessibility. The capacity to handle a number of calls at the same time varies significantly among the services. Of the services responding, 60% can handle only one call at a time; 22% of the services can handle up to two calls at a time; 7% of the services can handle up to three calls at a time; 10% of the services can handle four or more calls at a time. At the other end of the scale, the California Relay Service (CRS) can handle over 100 calls at a time.

Service Limitations

Service limitations are a source of anxiety for most relay service clients. For example, it is frustrating to attempt to reach a relay service for two hours and then be informed of a time limitation. Fortunately, some relay services impose limitations only during busy periods. Relay services may place one or more calling limitations on their clients:

- **Duration**--Length of the individual calls.

- **Quantity**--Total number of calls a client may make per day or per session (e.g., no more than three calls upon reaching the service).
- **Frequency**--Amount of time which must elapse between calls (e.g., client must wait 30 minutes before calling back).

- **Content**--Subject matter of the conversation. For example, some services will not relay fast food orders or personal/social calls.

Of the services responding to our survey, 31% place time limitations, 29% place quantity limitations, 5% place frequency limitations, 13% place content limitations, and 22% impose no limitations.

Long Distance Billing Methods

There are four different ways a relay service may handle charges for long distance calls:

- **Third-party billing**--The relay service asks the operator (long distance or local company operator) to bill the call to the client's telephone number. The operator can also bill the call to a person not involved in the relay call, with that person's consent.

- **Collect calling**--The relay service asks the operator (long distance or local company operator) to reverse the charges so that the receiving party (the party called by the client) is billed. The receiving party must agree to pay for the call.

- **Credit/calling card**--The client provides the relay service with his or her long distance company account number. The long distance company bills the client.

- **Direct dial**--The relay service is charged for the call and bills the client at a later time.

Based on responses to our survey, 22% of the relay services are willing to place long distance calls using any of the four billing methods mentioned, and 67% of the relay services will use any method except direct dial. If a relay service does not provide direct dial, then consumers should ask to use their calling/credit card. Over 99% of the relay services *offer* calling card and collect billing, but most services reported never *using* these methods.

Twenty-two percent of the relay services offer third-party billing, the method of billing with which most consumers are familiar. Relay services are also more familiar with third-party billing. In fact, although the services reported using the other three billing methods, approximately one-third of those services responding were initially unfamiliar with methods other than third-party billing. As a result of the familiarity, third-party billing is the most requested method.

Sometimes relay services encounter billing disputes over third-party-billed calls. To avoid billing problems, 1% of the services do not offer third-party billing and 1% of the services refuse to place any long distance calls. On the other hand, it is interesting that 1% of the relay services will place direct dial long distance calls at no charge to clients.

Bilingual Language Capability

Some relay services have on-staff operators who can relay calls in more than one spoken language. Some services require advance notification in order to schedule their bilingual relay operator to handle the call. Other services have bilingual operators on duty at all times. Spanish speaking operators are available at 15% of the responding services. Fewer than 1% of services have staff who can communicate in French, German, or Italian.

Computer Compatibility

Of the responding relay services, 31% reported being equipped to handle calls in 300 baud ASCII, a data transmission rate and code used in computer communications. However, most relay services reported never having used their ASCII capability and some reported not even knowing how to adjust the setting on their TDDs to prepare for such a call.

Some relay services may also be able to handle overseas calls. In order to do so, TDDs must be able to transmit in baudot at a rate of 50 baud. Some TDDs allow switching between 45.5 and 50 baud. (Consumers should check with their TDD relay service to learn if the service's TDD can handle overseas calling.)

Educating Consumers

The Tele-Consumer Hotline sees a need to educate consumers about telephone issues. Toward this end, we offer much descriptive information about relay services. In some metropolitan areas where several services are available, consumers can use the Hotline's charts to "comparison shop" for the most suitable service. For example, a consumer who needs to make a late-night call must select a service which provides overnight hours.

There is a wealth of practical information which needs to be disseminated to relay service consumers so they can take full advantage of the features offered by relay services. There are many money-saving tips which can help TDD consumers make the most efficient use of relay services. For example, if consumers need to use a relay service to call long distance, they have two options. The first is to use a local relay service. If the consumer's party does not answer the phone, he or she will not be charged for the call. If, however, his or her party *does* answer, the caller will *not* receive the TDD discount because the local relay service placed the long distance call. (Exception: The TDD discount is applied to calls relayed by AT&T-administered relay services.) Using a distant relay service located near the home of the person being called is the second option available. If the consumer's party does *not* answer the phone, he or she will still be charged for the long distance call made to the relay service. The second option is recommended if the consumer knows that his or her party is home because the consumer will receive the TDD discount on the long distance portion of the call.

Looking Toward the Future

Although the number of relay services has increased, there is still much room for improvement. Many rural areas, for example, still do not have a local relay service. It appears that telephone interpreting is becoming big business, and relay services are growing by leaps and bounds. Even with the implementation of more regulated statewide and nationwide relay services, there will always be smaller unregulated relay services to supplement the high consumer demand. Therefore, the need will always exist for up-to-date comparative information on the features of relay services as well as tips on how to use the services most effectively. The Tele-Consumer Hotline's publications meet this need, but equally important is the need for comparative information on the quality of the services. The Hotline is unaware of any study on quality from a consumer perspective. Such a research project could include placing test calls to the services to assess:

- **Accessibility**--The ability to connect to the service without a busy signal or long hold time.

- **Professionalism**--The neutrality or objectivity of the relay operator, the confidentiality of the conversation, and use of standard TDD etiquette and relay service protocol. For example, do relay operators clearly communicate the start and finish of a call to ease the transition between consecutive relay calls? Do they inform clients of any difficulties in the relay process, including being put on hold?

- **Competence**--The speed and accuracy of typing, use of abbreviations, appropriate voice tone and clear enunciation, and familiarity with the syntax of American Sign Language (ASL) to assist those who do not understand ASL in its transliterated form.

Our contact with relay services also indicates a need for the formation of a national association for relay service providers. Such an organization could coordinate the efforts of regulated and non-regulated services, set standards for quality, facilitate the sharing of information between relay services and consumers, and advocate for both consumers and service providers. This conference certainly provided the impetus for such a collaborative effort.

QUESTION AND ANSWER

Question: I was wondering if you included computer, something such as CompuServe, in your survey?

Answer: *No, we just surveyed the relay services. [The Tele-Consumer Hotline's TDD Relay Service Comparison Chart] shows the kind of services which either hearing impaired or hearing people can use to make calls through the telephone network.*

Comment: This is more of a reaction than a question, but I particularly want to commend Mr. Baquis on his clear definitions and distinctions between message

relay, dual party relay, and similar concepts. I think that these are very important distinctions, and I'm afraid that in recent times there has been a growing trend to confuse the terms more and more. I'm afraid that message relay has been used far too much to describe what is really dual party relay, and I would like to go on record as reinforcing the comments of Mr. Baquis on that.

Question [Virginia Stern]: I understand why everyone doesn't respond to a survey, but you said some [relay services] didn't respond because of confidentiality [about their services]. Why would relay services want to keep their identities confidential?

Answer: *There are some relay systems that provide a private relay service to select clients or friends. These services do not want to get swamped with calls from the public. For example, a university I contacted provided a relay service only for students on campus. In other cases, several people that work in the community might have a group of just seven [hearing impaired] people who use their service. I wanted to acknowledge that such services do exist, because that kind of service takes care of some of the burden that is placed on the public relay services.*

Question: Did those services that asked to remain confidential charge any type of fee?

Answer: *No, the ones I contacted were just doing it on the basis of good will.*

Question: How do you see the issue of privacy--which is a guaranteed right of all consumers--affecting long-term telephone relay service, or TRS? [Baquis: Are you thinking that because there are problems with confidentiality, that might inhibit the growth of relay services?] I'm thinking that confidentiality is something that we, as a country, have never been able to guarantee. Maybe I am jaundiced, but I don't see TRS going the long-term because I don't see how we can guarantee the privacy of the folks who are going to use TRS when we can't guarantee privacy for anyone.

Answer: *I haven't given a lot of thought to that, but there may be some opportunities in other workshops to work out the issue of confidentiality and how that is going to affect the continuation of relay services. I imagine that someone is going to find a way of working it out.*

Question: You don't have any information about anyone complaining about privacy?

Answer: *No, we have not been receiving complaints about confidentiality. We receive a lot of complaints about busy signals and not being able to get through, and being upset with relay operators not responding in the way that they should on the telephone.*

Question: I wonder, with telephone relay service, is there one assistant for each call or is there a new technology where they would take care of me, and at the same time take care of another person who is calling and go back and forth between the two of us to speed up the service?

Answer: *I think an ideal situation would be an operator who can give full attention to a single phone call, but there are some short-staffed relay services [whose staffs] are very frazzled and will try to handle more than one relay call at the same time.*

Comment: I would like to make a comment in response to that question. Technology within the telephone system is now available so that a relay system could, indeed, be handling multiple relay calls at the same time. It just has not been implemented yet. But it is a possibility, and it can be a reality quite readily. I would like to comment on that so that calls in the future could be handled much more quickly by relay operators handling multiple calls at the same time.

Question: You mentioned something about privacy in our TTY calls. That happened most often when the service used old TTY Western Union machines and they put the message on paper rolls, and the messages were saved. I object to that. I think all services should use plain non-paper TTY machines so they won't be keeping any records. Do you have any evidence that there are some services that keep the messages?

Answer: *No, I haven't heard of anything like that. Well, actually, some services may keep emergency messages for a short period of time but, no, I think relay services attempt to destroy any written directive of the conversation. Although I surveyed many relay services, our information is non-judgmental. There may be 300 services out there. It doesn't mean they are all good. Rather than ask the services how many calls they relay, I asked, "Would you be willing to relay a call if a deaf person called you up and asked*

you to do so?" What that means is I have located several services which I call relay services but which have never relayed a call before. But they are an untapped resource out there as a backup plan if one of the regularly used relay services is busy.

Comment [Joe Heil]: I would like to make a comment on privacy. There are some relay services which, either through misguided intentions or through lack of understanding, do maintain a hard copy. There are several reasons for that. One would be, "I need it in case I am handling an emergency call and something goes wrong--to protect myself." Another one is, "The organization I belong to requires me to keep it in the file cabinet for six months." A third is that "I need it to give volume reports." I think this is very serious for another reason that ought to go on record: Any police department in the United States can subpoena those records. You see, as a hearing person, when I talk to you, they can subpoena my phone bill and say I called you, but they don't know what I said. But the deaf person whose conversation is filed in the file cabinets is subject to subpoena in most jurisdictions on toll records. So that is a serious thing in hard copy when somebody files it for one reason or another. There is a new facet. People want to use personal computers for relay. You have the same problem there. Are you going to store it in memory? I think it is a very big issue.

Comment: One of the points that has been made is about the difficulty with [encountering frequent] busy signals when calling a relay service. I think if anything positive will come out of this conference (and many positive things, I'm sure, will come out of this conference), that would be to have public policy awaken the hearing community to provide more resources for human services throughout the country--whether through tax money or private foundation money--so that there is more staff, more equipment, and the use of the latest technology to improve accessibility. Working with a service myself for the last nine years, this is the primary difficulty. I think it's necessary to ensure that that be dealt with by increased revenue support so that there is more staff and improved technology to reduce this particular problem.

Comment: I would like to make one brief comment on the hard copy issue. I did a survey also and some of my respondents told me that they kept a hard copy only until the end of the operator shift. At the end of that time, those papers were turned over to the supervisor, who used them for quality assurance of that operator to check that they were relaying the messages appropriately and effectively. Then, at that time, they were destroyed. [Moderator: Do you mean they were tape recorded also?] No, the hard copy was kept so that they could look at how it was processed. The supervisor looked at that hard copy to make sure it was conducted as properly and efficiently as possible. And it was destroyed after it was checked. So there is perhaps some value in maintaining a hard copy briefly for quality assurance.

Comment: I want to pick up on [the moderator's] question because I think she asked whether or not the voice portion of the relay was also recorded. The paper is a form of recording a conversation but you cannot evaluate the competency of a relay by only looking at one half of the conversation. You need to know about the attendant's manner of speaking and how he or she translates the hearing impaired person's message.

Comment: I would like to comment first about saving messages in the hard copy. Recently--and I do not know the details--I read in the *Silent News* that a man's hard copy was used in court. I think if I had to depend on the relay service, I would be upset about that; but, on the other hand, people who are using the relay service almost need it in print because people talk at different rates. Sometimes it's very hard without a printer to know the whole content of what they are saying. I believe the copies should be destroyed immediately after. I think the volunteers do the best they can without appropriate training. There is no leadership and no place to get a proper training manual. It is very difficult to do that.

Comment: I was a volunteer on a relay service for seven years. During this time I handled maybe 10,000 incoming calls. Over a period of time, I realized that the phraseology of some of the particularly personal questions was sufficiently complicated--because I did not know the characters involved or the circumstances--that it was helpful for me to have a printout of the TTY conversation. That enabled me when I made the vocal call to simply read the text of what I had. Although I didn't know what it was, I didn't want to go back and quiz the deaf person as to who was who and what was what. I would say 99% of the time that I simply read the text, the person at the other end of the call knew exactly what it was about. This way, having a printed text, which I would keep only for this purpose, was invaluable. It enabled the call to go through smoothly and efficiently.

Answer: ***Perhaps the new wave in the future will be to have a whole computer monitor so you can see 24 lines lined up right on top of each other.***

Notes

1. The Tele-Consumer Hotline's toll-free number is 1-800-332-1124.

Appendix 1

The Tele-Consumer Hotline's Special Needs Program

What is the Tele-Consumer Hotline's Special Needs Program?

The Tele-Consumer Hotline is a free consumer information service for all consumers in need of assistance in dealing with their telephone shopping requirements. Founded in 1984 by the Consumer Federation of America and the Telecommunications Research and Action Center, the Hotline has endeavored to meet the informational needs of tens of thousands of consumers.

The Hotline's Special Needs Program is designed to focus Hotline resources on meeting the unique needs of those with special requirements due to physical impairments. Hotline staff recognized that there is little information readily accessible about equipment specially designed to aid consumers with speech, vision, hearing, mobility, or mental impairments. The situation has created an urgent need for quality information about the cost and availability of equipment necessary to ensure that those with impairments have continued access to the basic telephone system.

The Hotline's Special Needs Program features live counselors at a toll-free number, 1-800-332-1124 (voice/TDD) to:

- ***Answer Questions:*** Hotline counselors can help answer questions such as: what type of equipment will help me communicate more effectively, given my impairment (speech, hearing, vision, motion, mental)? How much does the equipment cost? Where can I buy it in my area? Should I buy or rent phones? Where can I get my equipment repaired?
- ***Send Information:*** The Hotline publishes a number of helpful free publications. These include its special needs ***Shoppers' Guide,*** a TDD relay comparison chart, TDD directory book listing, long distance comparison chart and fact sheets that answer a variety of questions about telephone service. All material is available in large type for consumers with low vision.

What Information Does The Hotline Provide?

- ***Shoppers' Guide*** — The Guide is a document specially prepared for each individual, based on type of impairment. This information is derived from an electronic database created by the Hotline research staff. The information lists retailers who sell the equipment, a description of the equipment and the cost of the equipment (by retailer). A version of the Guide is also available in Braille.
- ***Special Needs Factsheet*** — Factsheets provide detailed information on matters unique to those with impairments, plus helpful facts such as how to qualify for special exemptions, free directory assistance calls and discounts on long distance calls.
- ***TDD Relay Center Comparison Chart*** — Relay services help TDD users and non-TDD users communicate with one another. Relay service personnel pass along an on-going conversation or message between the TDD user (by TDD) and non-TDD user (by voice). The Chart offers comparative information such as area served, membership requirements, fees, and other service limitations.
- ***TDD Directory Listing*** — This is a directory of directories, listing available TDD directory books. These books are invaluable because they contain emergency numbers, government, special agencies, travel agencies, banks, schools, libraries and lawyers who have TDD numbers.
- ***Factsheets*** — Five factsheets and regional long distance company comparison charts are available in Orator 10 print for consumers with low vision, and in Spanish. The factsheets include:
  - ***— How to Choose a Long Distance Company***
  - ***— Equal Access - The New Long Distance System***
  - ***— How to Buy a Phone***
  - ***— What to do When Your Phone Doesn't Work***
  - ***— How to Start Long Distance Phone Service***
- ***Long Distance Analysis*** — For vision impaired consumers, the Hotline will provide a discounted cost comparison of their long distance telephone bills. The cost comparison analyzes the consumer's actual telephone bill and reveals how much it would cost to use the different companies. The analysis is based on 30 different calls and the results are read over the telephone to the Hotline's client.

Appendix 2

List of TDD Relay Services Across the United States

Notes:

1. Relay services are listed under the states(s) where their offices are located although many relay services extend services to consumers residing in other states.

2. Asterisks identify unlisted relay services. Descriptive information about these services does not appear on the ***Tele-Consumer Hotline's TDD Relay Services Comparison Charts***. Since information about unlisted relay services has not been confirmed by the Hotline, readers should check with the relay service prior to sharing its number with the general public. The names of unlisted services are provided to illustrate the tremendous amount of relay services. The Tele-Consumer Hotline has discovered and will research many relay services in addition to those listed.

Tele-Consumer Hotline's TDD Relay Services Comparison Charts

National

"National" means that the organization serves consumers across the country. It does not imply that the service is free, accessible via a toll-free number, or available 24 hours a day.

Federal TDD Relay Exchange (cross listed under D.C.)
Telephone Interpreter Service for the Deaf (cross listed under Indiana)
Senate Special Services (cross listed under D.C.)
* U.S. Congressional Telecommunications Center for the Deaf (cross listed under D.C.)

Alabama

Alabama Institute for the Deaf-Blind (Dothan)
Alabama Institute for the Deaf-Blind (Huntsville)
Contact Mobile
Independent Living Center
Janice Capilouto Center for the Deaf
VOA Mobile Center for the Hearing Impaired

Alaska

Juneau Interpreter Referral Line
* Crisis, Inc.

Arizona

Arizona Council for the Hearing Impaired

Arkansas

Office for the Deaf and Hearing Impaired (13 offices)

California

California Relay Services
Contact Pasadena
The Darrell McDaniel Independent Living Center
Foundation for Living
Greater Los Angeles Council on Deafness
I.T.S. Communications
Independent Living Resource Center
Rolling Start Deaf Services
Silent Connections
Temple United Methodist Church
* American Red Cross
* Answerfone
* Carol Walter
* Center for Independent Living
Community Resources for Independence
Deaf Community Services of San Diego
* Deaf Informed Community Resource Center
Inland Service Center
* Norcal Center on Deafness
* Richmond Library
* Suicide Prevention of Alameda County
* Trinity Baptist Church

Colorado

Center on Deafness
Disabled Resource Services
Volunteers of America
* Colorado State University
Denver Commission on the Disabled
Northern Colorado Center on Deafness
* Pikes Peak Center on Deafness

Connecticut

* Converse Communications

Delaware

Contact Delaware

District of Columbia

American University
Capcom, Inc. (cross listed under Maryland)
DeafLink Hotline
Federal TDD Relay Exchange (cross listed under "National")
Senate Special Services (cross listed under "National")
(TEDI) Telecommunications Exchange for the Deaf, Inc. (cross listed under Maryland and Virginia)
Washington Connection

* District of Columbia Center for Independent Living, Inc.
* St. Elizabeth's Hospital
* Senior Center for the Deaf
* U.S. Congressional Telecommunications Center for the Deaf (cross listed under "National")

Florida

Big Bend Service Center
Broward County Hearing and Speech Association
Deaf Service Bureau
Deaf Service Center
Deaf Service Center, Inc.
Deaf Service Center of Palm Beach County
Deaf Service Center of West Central Florida
Deaf Service Program Center for Independent Living
United Hearing and Deaf Services
* Crisis Line Information and Referral Services
* Contact Miami
* Deaf Service Center of Jacksonville
Deaf Service Center of Manatee, Inc.
* Deaf Service Center of Volusia County
* Gulf Coast Deaf Service Center
* Health and Resource Line
* Speech and Hearing Association of Southwest Florida

Georgia

Atlanta Deaf Action Center
Contact Hall County
Cruselle--Freemont Center for the Deaf

Hawaii

* Hawaii Services on Deafness
* Message Relay Service

Idaho

* Idaho Falls Relay Service
Tel-CAR, Inc.
* Twin Falls Relay Service

Illinois

Chicago Emergency Services
Crisis Line of Will County
Deaf Contact Chicago
Department on Aging Information and Referral Center
Mayor's Office of Inquiry and Information
Contact Rockford
* Contact Stevenson County
Jacksonville Community Center for the Deaf

People Assuming Control over Environment (PACE)
Sertoma Center for Communicative Disorders

Indiana

Contact Cares
Interfaith Deaf Relay
Telephone Interpreter Service for the Deaf (cross listed under "National")
Community Services for the Deaf
* Contact--Help
* Deaf Services, Inc.

Iowa

First Call for Help

Kansas

City of Olathe Relay
Johnson County Deaf Services
Kansas Commission for the Deaf and Hearing Impaired
Olathe Public Library
Topeka Pubic Library

Kentucky

Relay Service for the Deaf

Louisiana

Deaf Resource and Communication Center
Louisiana School for the Deaf
St. Francis deSales Catholic Deaf Center
* Catholic Deaf Center

Maine

Ingraham Volunteers

Maryland

Capcom, Inc. (cross listed under D.C.)
Family Life Center
Frederick County Services for the Hearing Impaired
Hartford County Library
Hearing and Speech Agency of Baltimore
Howard County Library
LINK Relay Message Service
* TEDI (Telecommunications Exchange for the Deaf, Inc. [cross listed under D.C. and Virginia])
Eastern Shore Point of Contact for the Deaf
* Montgomery College
* Montgomery County Department of Public Libraries (seven branches with TDDs)
* Washington County Disabled Citizens

Washington County Deafnet Association
* Montgomery County Division of Service to Handicapped Individuals
* Montgomery County Information and Referral
* Municipal Telephone Exchange
* National Catholic Office for the Deaf
* Prince George's Community College
* Private relay service (College Park)
* Private relay service (Silver Spring)
* Private relay service (Kensington)
University of Maryland Help Center
Wheaton Community Services Center

Massachusetts

D.E.A.F. (Deaf Education and Advocacy Foundation)
* Amherst Fire Department

Michigan

ARC Resource Center
Center for Handicapped Affairs
Center for Living Independent
Common Ground
Community Services for the Hearing Impaired
Gryphon Place
Independent Living Program
Kalamazoo Center for Independent Living
Michigan Association for Better Hearing and Speech
Oakland--Livingston Human Services Agency
Social Services for the Hearing Impaired
THEE Telephone Answering Company
* Detroit Hearing and Speech Center
* Grand Rapids Center for Independent Living
* Superior Answering Service

Minnesota

* D.E.A.F.
* First Call for Help (St. Paul)
* First Call for Help (Minneapolis)
* First Call for Help (Grand Rapids)

Mississippi

* Del Epee Deaf Center

Missouri

Contact St. Louis
Research Medical Center

Montana

Montana Independent Living Project Outreach
* Matthew's Telephone Answering Service

Nebraska

Nebraska Commission for the Hearing Impaired

Nevada

Northern Nevada Center for Independent Living
* Deaf Resources

New Hampshire

Helpline

New Jersey

Contact
Contact Atlantic
Deaf Contact 201
Deaf Contact Morris--Passiac
Deaf Contact of Mercer County
Ocean County Library
Ocean County Office for the Disabled
* Bergen County Office on the Handicapped
* First Call for Help
* Ocean County Sheriffs' Department

New Mexico

New Mexico Registry of Interpreters for the Deaf
* New Vistas Independent Living Center

New York

Capitol District Deaf Center
Corning A.I.M.
Deaf Contact
Hi-Line
New York Society for the Deaf
Volunteer Center/Helpline
Westchester County Office for the Disabled
Western New York Service for the Hearing Impaired
* Capitol District Deaf Center
* Henrietta Public Library
* Long Island Center for Independent Living
NTID/RIT Telecommunications Center (National Technical Institute for the Deaf)
* Queens Public Library
SILO (Suffolk Independent Living Organization)

North Carolina

Charlotte Community Service Center
Deaf Contact (Winston-Salem)
First Line
Greenville Community Service Center
Guilford County Communications Center for the Deaf
Morganton Regional Community Services for the Hearing Impaired
Reach Line
Wilkes Deafness Center
Wilmington Regional Community Services for the Hearing Impaired
Winston-Salem Deafness Center
* Deaf Contact (Asheville)
Raleigh Community Service Center for the Hearing Impaired

North Dakota

Vocational Rehabilitation
Deaf Awareness

Ohio

Callvac Services, Inc.
Help Hotline, Inc.
Scioto Drug Abuse Council
* Chagrin Answering Service
* Contact Community Connections
* Contact Trumbell
* Deafline/Contact Queen County
* Westerville Public Library

Oklahoma

State of Oklahoma Services for the Deaf and Hearing Impaired
* Contact Northwest Oklahoma

Oregon

* Northwest Ansir

Pennsylvania

Berks County Association for the Hearing Impaired
Contact Chambersburg
Contact Harrisburg
Contact Lower Bucks
Contact Philadelphia
Contact York
Deaf Contact--Lancaster
Erie Hotline
F.I.R.S.T.
Helpline
Pennsylvania Department of Health, Hearing, and Speech Program

Vocational Rehabilitation
Westmoreland County Deaf Services
* Contact Altoona
Deaf Hearing Community Center
Hearing Conservation/Deaf Service Center
* Laverne Walters

Rhode Island

* Red Cross
* Helpline

South Carolina

Helpline

South Dakota

Community Service for the Deaf

Tennessee

Family and Childrens Services
Interpreting Service for the Deaf
Knoxville Area Communication Center for the Deaf
League for the Hearing Impaired
* Deaf Contact Chattanooga
* Deaf Contact Cleveland
* Deaf Contact Johnson City
Deaf Contact Kingsport
* Deaf Contact Knoxville
* Regional Center for the Hearing Impaired

Texas

Central Texas Council for the Deaf
Corpus Christi Area Council for the Deaf
Deaf Action Center
East Texas Deaf and Hearing Association
El Paso Center for the Deaf
Hear-Say
Highland Council for the Deaf
Lubbock Community Services for the Deaf
Operation Howdy (Goodrich Center for the Deaf)
Travis County Service for the Deaf
West Texas Service for the Deaf
* Answering Service for the Deaf
* Deaf Council of Greater Houston
* Houston Center for Independent Living
Houston Fire Department

Houston Public Library
* Message Masters
MHMR Hotline
Panhandle Council
* San Antonio Council
* Southeast Texas Council for the Hearing Impaired
* Texoma Council for the Deaf

Utah

Whitmore Library
* Utah Community Center for the Deaf

Vermont

* Central Answering Service

Virginia

ACTS--Helpline
Communications Center for the Deaf
Contact Peninsula
Contact Tidewater
TEDI (Telecommunications Exchange for the Deaf, Inc. [cross listed under D.C. and Maryland])
* Arlington Library
* Citizens Assistance and Information

Washington (State)

Pierce County Rape Relief
Spokane Service Center for the Deaf
TACID (Takoma Area Council for Individuals with Disabilities)
Yakima Valley Center for the Deaf
Community Service Center for the Deaf and Hard of Hearing
* Contact Tri-Cities

West Virginia

Contact Huntington
Coordinating Council for Independent Living
* Appalachian Center for Independent Living
Contact Kanawha Valley

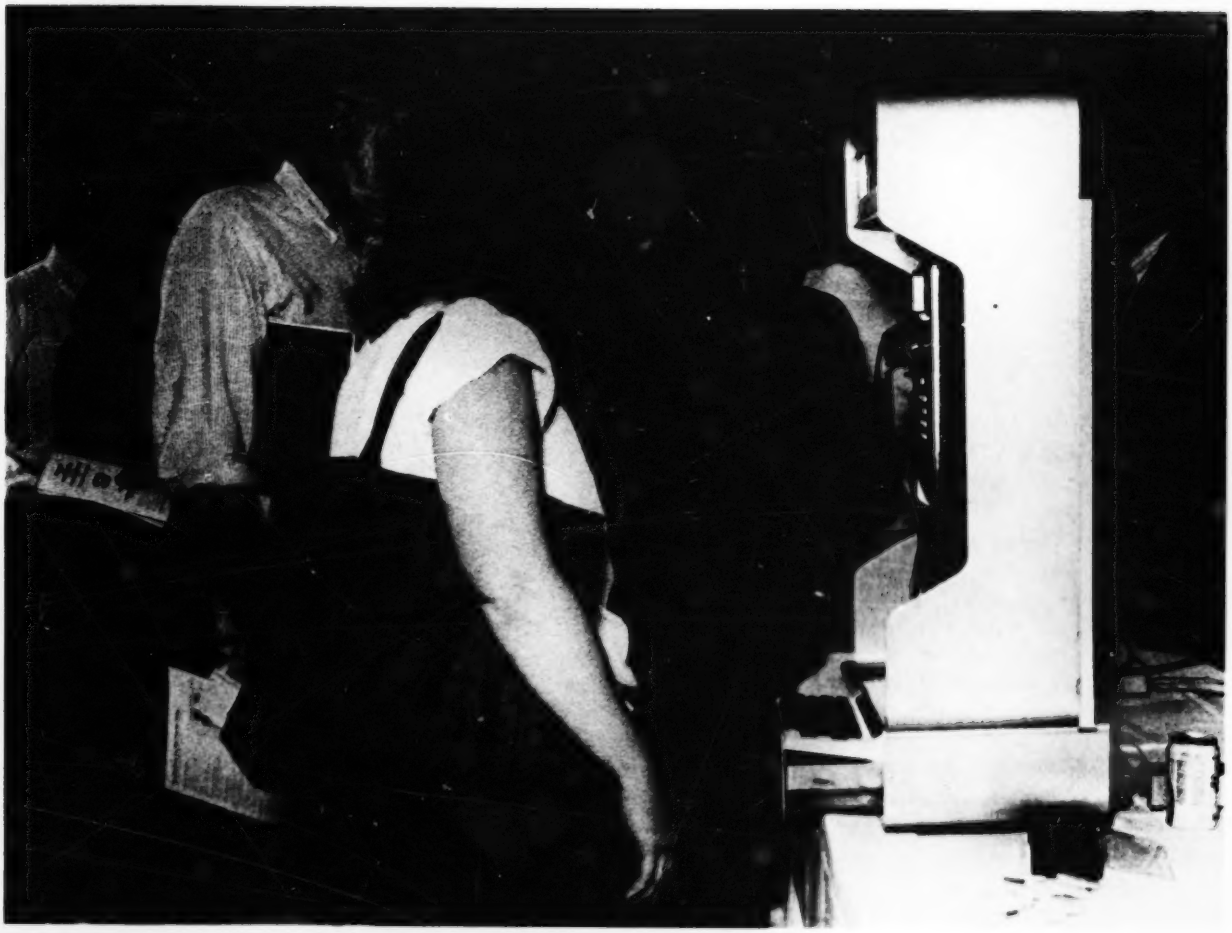
Wisconsin

Dane County Message Relay Service
Developmental Disabilities Service Center
Family Service Association
First Call for Help
Fond Du Lac Department of Social Services
Madison Fire Department
Milwaukee Hearing Society
St. Elizabeth Hospital

Society's Assets
- Marathon County Public Library
- Outreach Line
- Tapline

Wyoming

- Vocational Rehabilitation (four offices)



Speech to Text participants examine Ultratec's pay phone TDD during the conference exhibit.

RECENT FEDERAL ACTIVITY REGARDING RELAY SERVICE

Karen Peltz Strauss[*]

[Editors' Note: This paper was revised by the author to incorporate significant federal actions taken a month after the Speech to Text: Today and Tomorrow conference.]

In recent years, various states have finally begun to take action toward the establishment of dual party TDD relay systems. While few more than a handful of states have relay programs that are in operation, many more--approximately fifteen--are in the process of studying the development of a relay system or, having allotted funds for a system, are exploring the means by which to establish and maintain its operation. Given this state activity, what should be the role of the federal government in the provision of relay services? If federal action is needed, what form should it take--is the Federal Communications Commission (FCC or Commission) equipped with sufficient authority to order these services? Or is federal legislation needed to finally achieve equal access for hearing impaired persons to intra- and interstate telecommunications services? These questions and a discussion of action taken by the federal government on these matters will be explored in this paper.

Need for Federal Action

Although many states have begun establishing dual party relay systems, these systems have only offered a beginning to providing telephone access for hard of hearing and deaf consumers. First and foremost, the vast majority of states still do not have a relay system in operation at the present time. In addition, many of those that do have systems suffer funding and staff shortages, placing severe limitations on telephone access. Some of the programs rely on volunteers; others place time limits on the length of calls; still others offer services only during limited hours and days of the week.

For those states seeking to establish programs, development of those programs is often hampered by repeated delays. Because there has been little or no coordination among the states in developing the relay programs, each state is forced to start afresh in making decisions about the funding, operation, and standards for its program. The result is that needless duplication of efforts takes place, and critical relay services are delayed pending the outcome of decisions that have been made time and time again in other states. A single nationwide system, with coordination among all of the states, would eliminate these repeated delays.

Perhaps the most critical need for federal intervention in the development of relay services stems from the failure of most current state systems to offer interstate relay services. The California Public Utility Commission (PUC), for example, has refused to order the provision of these services out of its concern that it does not have sufficient authority to do so. Without the ability to make interstate relay calls, hearing impaired persons will continue to be denied full and equal access to our country's telecommunications network.

At the same time that the existing state programs have confronted difficulties, the demand for relay services has risen to overwhelming proportions. In California alone, the relay system currently handles more than 200,000 calls each month, up from an original demand of 50,000 calls each month. Few states, including California, have been able to maintain

[*] Karen Peltz Strauss, J.D., L.L.M., Supervising Attorney, National Center for Law and the Deaf, 800 Florida Avenue, N.E., Washington, DC, 20002

the capacity to handle this tremendous demand for services. It is easy to conclude that federal guidance and/or financial assistance is critically needed to assist in meeting this demand.

Past Federal Activity

After many years of inaction, on April 24, 1987, the FCC adopted a Notice of Inquiry requesting comments and factual information on the provision of communication services and equipment to hearing impaired and other disabled persons [CC Docket 87-124 (released May 15, 1987, reported at 52 Fed. Reg. 19198, May 21, 1987)]. In this proceeding, the FCC promised, depending on the responses it received, to evaluate the need for additional regulatory or legislative action to ensure reasonable telecommunications access for deaf persons. In response to the FCC's request for comments, a number of interested parties expressed support for the creation of an interstate relay service throughout the United States.

In an action designed to follow up on the FCC's April 24th Notice of Inquiry, the National Association of Regulatory Utility Commissioners (NARUC) on October 1, 1987, submitted a petition to the FCC requesting that the Commission establish a committee composed of state and federal regulatory officials, hearing impaired customers, and communications providers. The petition asked the FCC to issue a Further Notice of Inquiry in which the FCC would request interested parties to submit specific proposals for the establishment of an interstate relay service to the committee. NARUC's petition urged the Commission to avoid further delay after decades of limited telephone access for hearing impaired persons. It requested the Commission to finally develop a federal policy on an interstate system "so that inter- and intrastate developments can be coordinated, thereby reducing duplication, confusion, and costs to both hearing and hearing impaired subscribers."

Current FCC Proceeding

On March 24, 1988, in apparent response to the comments received on its initial NOI and the NARUC petition, the FCC adopted a Further Notice of Inquiry (Further NOI) seeking specific proposals for the implementation of an interstate relay system [CC Docket No. 87-124 (released March 29, 1988, reported at 53 Fed. Reg. 12546, April 15, 1988)]. The FCC acknowledged NARUC's request for a federal policy that would achieve consistency and coordination among intra- and interstate systems, and explained that the proposals sought should be of a nature that would enable persons with hearing and speech impairments to carry on real-time interstate telephone conversations with voice telephone users. The Commission specifically requested information on the need for an interstate system, an economic and technical analysis for the operation of a system, proposed rules for its use and administration, and an analysis of the Commission's authority to order a system and establish a mechanism for its funding.

Comments on the FCC's Further Notice of Inquiry

The FCC received a major response to its Further NOI. Over 50 organizations representing hard of hearing and deaf telephone subscribers throughout the country submitted comments offering suggestions on the establishment of an interstate telephone relay service. Numerous comments were received from providers of telecommunications service and equipment, and comments also were submitted by state public commissions that have established and operated local relay systems.

Virtually all of the commenters spoke out in support of the establishment of a nationwide interstate relay system. Those states that had already established relay systems for intrastate calls reported on the benefits of such systems to their hearing impaired populations.[1]

While a few commenters questioned the FCC's authority to fund an interstate relay system,[2] most seemed to agree that the FCC does have sufficient jurisdiction to mandate and fund such a system.[3] Moreover, the need for FCC involvement in the establishment of an interstate program was readily apparent throughout the comments submitted. This was best exemplified by an opinion submitted by the California PUC in which the PUC refused to extend its relay system to interstate calls for fear of overstepping its jurisdictional boundaries.

Commenters varied on what they saw as the proper role for the FCC in the establishment and operation of an interstate relay system. Only a few commenters sought to limit the Commission's involvement to a minimum. One of those commenters, the United States Telephone Association (USTA), requested the FCC to encourage "voluntary entry into the TDD relay business by carriers and others" (USTA Comments at 9). Similarly, AT&T urged leaving implementation of a relay

system to the states, and requested that the FCC merely identify an agency or trust fund which would ultimately be responsible for managing and administering the system.[4]

Many, if not most, commenters recommended that the FCC establish an advisory body to design, implement, and manage an interstate relay system.[5] The National Center for Law and the Deaf (NCLD) recommended that this advisory body be composed of individuals with hearing and speech impairments, the FCC, state regulatory officials, and representatives of the interstate carriers and relay services.

In its initial NOI of April 24, 1987, the FCC requested opinions as to the establishment of an advisory committee that would address issues of telecommunications access for disabled individuals. Notwithstanding public support for the creation of such a committee, in its Further NOI of March 24, 1988, the FCC rejected the establishment of a formal advisory committee. At that time, the Commission stated that "advisory committees should be established only when they are determined to be essential and their functions cannot be performed by Commission staff or by an existing committee" (CC Docket No. 87-124 at 25). The Commission concluded that a committee to study telecommunications access issues was not "essential."

Given the general agreement among both industry and consumers--as reflected in the recent comments to the Further NOI--on the pressing need for an advisory body, it is possible, and hopeful, that the FCC will reconsider its decision to reject the establishment of an advisory board. Indeed, although the FCC already rejected creation of a board for the purpose of studying general telecommunications access issues, it may very well agree to its creation for the more limited purpose of developing an interstate relay system.

Commenters also generally agreed upon the need to coordinate the establishment of an interstate relay system with existing intrastate relay programs. Many felt that creation of a system designed to handle only interstate communications would be inefficient and would merely duplicate services already provided.[6] Existing programs, some suggested, might be capable of handling some of the interstate calls, which would, in turn, lower the costs of an interstate system.[7] Similarly, NCLD explained that:

> ***By working together, interstate and intrastate jurisdictions could take advantage of greater economies of scale and operational flexibility. Certain operational expenses could be shared, including costs associated with facilities, labor, administration, publicity, and research. Close coordination would also allow for consistency among the various states in their relay services (NCLD comments at 18).***

This, in turn, would minimize confusion among telephone subscribers as to the scope and operation of the various relay services. Toward this end, NCLD urged the FCC to act quickly to establish a relationship between intra- and interstate relay systems. Further delay, NCLD noted, could only make coordination with states that are now planning their systems more difficult.

The principal source of disagreement among commenters to the FCC's Further NOI was in the manner in which each believed that an interstate relay system should be funded. Organizations representing hearing impaired individuals suggested that each interstate carrier be required to make contributions into a general fund, the amount of such contribution to depend on the number of common lines presubscribed to that carrier.[8] Funding of this kind, they explained, would treat these costs as one more cost of providing interstate telephone service, rather than as a special cost attributable only to the hearing impaired population.

Telephone service providers, on the other hand, suggested that funding for an interstate program should come from governmental appropriations, whether on the state or federal level. These companies shared the belief that the costs should be absorbed by general taxpayers.[9] AT&T offered other funding alternatives, including the placement of a surcharge on local exchange lines or the placement of such costs on the local exchange carriers, ultimately to be absorbed in the rates of those carriers. Not surprisingly, some local exchange carriers who submitted comments rejected this method of funding, fearful that either they or their customers would bear the burden of providing interstate services.

Several commenters set forth minimum standards of operation for an interstate system. Among the more important of these guidelines were the following standards:

- accessible relay services 24 hours a day, seven days a week;
- special training for relay operators, including knowledge of American Sign Language, typing, spelling, vocabulary, and the cultural and linguistic differences between the hearing impaired and hearing communities;

- prohibitions against censorship or editing of messages;
- strict codes of ethics and confidentiality of calls;
- access through Baudot and ASCII codes; and
- prohibitions against the imposition of additional charges for use of the relay services.

In addition, several commenters recommended that relay service users be granted discounts on their telephone rates, given the longer amount of time they need to complete relayed calls.[10]
Finally, most commenters agreed that, for the present time, relay operators would be needed in an interstate relay system. Automated services, they concluded, are possible only in the distant future.[11] Nevertheless, virtually all commenters urged the FCC to remain open to new, automated technologies that might one day replace manual systems.

The Next Step

Reply comments on the FCC's Further NOI were due by September 9, 1988. It is now incumbent upon the Commission to review all the comments carefully and to act promptly to establish an interstate relay system. The Telecommunications Accessibility Enhancement Act, P.L. 100-542, signed by the President on October 28, 1988, requires the Commission to complete its inquiry into this matter within nine months after that law's enactment. Pending the completion of the FCC's review, representatives of organizations of and for hearing impaired subscribers have urged the Commission to establish an interim relay system. Specifically, they have proposed that all interstate carriers be required to provide connections to those intrastate relay services already provided by local exchange carriers and to recover the costs of the interstate calls in the rates charged by the interstate carriers. As stated in their comments, "connection to existing interstate relay services could occur almost immediately, offering thousands of hearing impaired individuals their first opportunity to place and receive interstate calls without regard for whether the other party to the call had a TDD."[12] Similarly, comments by AT&T suggested that the Commission could order interim relief should it choose to do so. AT&T explained that industry already has the technical equipment, standards, and know-how necessary to begin a nationwide dual party relay system.

A nationwide interstate relay system is critically needed to ensure that hearing impaired individuals receive equal access to the interstate telephone network. Toward this end, the FCC should use its current authority to mandate the operation and funding of interstate relay services. However, even with an interstate system in place, millions of TDD users may remain without a means to make local calls in those states which lack local relay systems. It is unclear whether the FCC has jurisdictional authority to mandate intrastate relay services. To the extent that the Commission lacks such authority, the Commission should support federal legislation which would mandate and assist in the development of intrastate relay services. Only with the provision of comprehensive nationwide intra- and interstate services will the promise of equal telephone access finally be realized for individuals with impaired hearing and speech.

Other Federal Activity

In August of 1986, the Architectural and Transportation Barriers Compliance Board (ATBCB) and the Department of the Treasury began a trial relay system within the federal government. The system was intended to be used for relay calls to, from, and within the federal government. Unfortunately, the ATBCB's relay program has been insufficient to meet the need for relayed calls within federal agencies. According to a recent Senate report, the system has only one operator, two TDDs, and two answering machines. It does not make provision for the replacement of that operator should he or she take sick or annual leave (S. Rep. No. 100-464, 100th Cong., 2d Sess. at 6). Moreover, the current ATBCB program has not been well advertised. Many deaf governmental workers are unaware of its existence; most deaf persons outside the government are unaware that they can reach governmental offices through this service.

The ATBCB's program was initiated on a trial basis only and was scheduled to expire by September of 1988. P.L. 100-542 directs the Administrator of General Services, the FCC, and other federal agencies to continue the existing federal relay service and to add at least one additional operator to the system. The Senate report to the legislation explains that additional operators and equipment should be added if they are necessary to accommodate the demand for relay calls (S. Rep. No. 100-464, 100th Cong., 2nd Sess. at 6). In addition, P.L. 100-542 requires the Administrator to conduct a thorough analysis of the need for modifications to the federal relay system within 180 days of the legislation's enactment, after which time the Administrator is directed to prescribe regulations needed to assure full access to the federal telecommunications system for hearing impaired and speech impaired individuals.

In its report on S. 2221, the Senate recognized the benefits of and the need for expanded relay services.

It explained that with an increase in the number of TDDs installed in federal agencies came an increase in the number of relayed calls and, in turn, an improvement in the performance of federal employees with hearing and speech impairments. The Senate concluded that "the number of calls to and from agencies using the relay exchange clearly demonstrates that there is a need for the service . . . It has long been recognized that all employers should take whatever steps possible to fully integrate persons with physical impairments into the work force. In the case of hearing impaired and speech impaired individuals, the costs of installing TDDs and operating the relay service are small in comparison to the resulting benefits" (S. Rep. No. 100-464 at 2).

Conclusion

After many years of silence on this issue, the federal government has finally begun to consider and act upon the need to improve telecommunications access for persons with hearing and speech impairments. The FCC's ongoing proceeding on interstate relay services and the recent federal legislation for a federal relay system are most encouraging. Consumers should take an active role in these and other governmental efforts to realize the development of relay services throughout the 50 states.

Notes

1. As noted above, the California PUC reported that demand for the relay system has been "overwhelming, far surpassing original projections." California PUC Comments at 2. See also comments submitted by the Telecommunications Access for Communications Impaired Persons Board, which discuss the utility of the Minnesota relay service, and by the New York Public Service Commission, which discuss the benefits of a New York's new relay system.

2. See comments submitted by BellSouth, South Central Bell Telephone Company, and Southern Bell Telephone and Telegraph Company (collectively referred to herein as "BellSouth").

3. See, for example, comments submitted by the National Center for Law and the Deaf, COR, et al. (NCLD), NYNEX Telephone Companies (NYNEX), and the Bay Area Center for Law and the Deaf, Inc. NCLD's comments explained that the Commission's authority stems from the Commission's universal service goal, as set forth in the Communication Act of 1934, to ensure that communication service is available to all Americans so far as possible. Additional authority is derived from that provision of the Telecommunications for the Disabled Act of 1982 which authorizes the Commission to adopt regulations ensuring access to hearing impaired individuals.

4. NARUC, too, suggested that the states carry out the administration of an intra- and interstate relay system.

5. NARUC, GTE, NYNEX, the California PUC, Southwestern Bell, Pacific Bell, and Cincinnati Bell were among the commentators that recommended the establishment of an advisory board, task force, or national forum which would provide guidance and establish standards for the implementation of a nationwide relay system.

6. See, for example, comments submitted by NCLD, NYNEX, BellSouth, Pacific Bell, Cincinnati Bell, and Ameritech Operating Companies.

7. See comments submitted by Southwestern Bell.

8. See NCLD comments at 9-12.

9. See comments submitted by AT&T, GTE, Mountain States Telephone and Telegraph Company, Northwestern Bell and Pacific Northwest Bell, BellSouth, NYNEX, and Bell Atlantic.

10. See comments submitted by NCLD, AT&T, Bay Area Center for Law and the Deaf, and Southwestern Bell. In a recent report, the Senate Committee on Commerce, Science and Transportation also recognized the higher costs associated with TDD calls. In that report, the Senate called upon the FCC to determine whether interstate exchange carriers should be ordered to provide relay services at a reduced rate. Currently, as the report notes, AT&T is the only such carrier that provides discounts for TDD calls. See S. Rep. No. 100-464, 100th Cong. 2d Sess. (August 9, 1988) at 6.

11. See, for example, comments submitted by AT&T, California PUC, and Southwestern Bell.

12. NCLD comments at 31.

QUESTION AND ANSWER

Question: I take very well the five items you mentioned in the standards of service. I would like to ask you to add one more--that, in keeping with the spirit of full accessibility, the availability of telephone relay operators be the same as the availability of the operators in the regular telephone networks.

Answer: *That's definitely listed in the federal proposal that we were establishing.*

Question [Michael Hurst]: Have you had any feedback from the FCC staff on the possibility of interim relief?

Answer: *Consumer groups that commented on the NOI [Notice of Inquiry] suggested that the FCC establish "interim relief" while considering all of the comments. Interim relief would set up an interstate relay service for at least those states that already have intrastate relay systems. The answer is that we have not received any word back from the Commission on interim relief. For one thing, the reply comments were just submitted a few weeks ago, and I would imagine the FCC would want to review those. I have to say that I would like to be more optimistic than I am about the speed with which the FCC is going to move on this.*

I am, however, very pleased that something has been done. Like I say, tremendous progress has been made within the last year when you compare it with the last 54 years; however, given the long time that it has taken to reach this point, I think it is going to be a little bit longer before we hear back from the FCC on this.

Question [Judy Tingley]: In listening to the areas that you would want to see covered by a system, are you including any standards related to communication to the hearing party on the other end? I heard you talking about the need to have skill in dealing with the consumers using ASL, but are you considering the need to communicate to the hearing person--what standards you expect with regard to diction?

Answer: *That is one of the items listed: grammar, vocabulary. It has to be somebody who can take an ASL message and put it into good English, if that is what the hearing person requires. Yes, it goes both ways. There has to be knowledge of what the hearing impaired individual uses, and what the hearing individual uses.*

Question [Sheila Conlon-Mentkowski]: Related to the Americans with Disabilities Act: I know that Section 504 says that if people violate the law, their federal funds will be taken away until they start complying again. Can you tell me what penalties are associated with the Americans with Disabilities Act? Suppose it passes, what will happen if anyone in the private sector violates the law?

Answer: *I can tell people the major difference between this Act and Section 504 of the Rehabilitation Act. Section 504 covers only federal programs and activities that receive federal financial assistance. This Act goes much further. This Act affects the private sector. That is the main difference between the two pieces of legislation. This act would affect any entity that Title 7, which covers private employers, would affect. Now, most broadcasters, if not all, with the exception of public broadcasting systems, do not receive federal assistance. For that reason, courts have repeatedly said that broadcasters are not under any particular requirement to expand their captioning services, for example. They are completely private entities even though they receive federal licenses.* [Editors' Note: Ms. Strauss supplied the following additional information, which she did not have in hand at the time of the conference: As written, I believe the Act would allow the various federal agencies responsible for implementing the Act to determine the appropriate penalties when there are violations of the Act. The Act itself does not prescribe specific penalties.]

Question: Suppose a nonprofit organization refuses to get a TTY to serve the hearing impaired because [the people in the organization] are afraid that they are not going to be able to communicate with deaf people and because they don't have an interpreter there. Has anybody been taken to court or a judgment filed against them for not providing a TTY in facilities where it is needed for the hearing impaired?

Answer: *Many complaints have been filed against organizations that receive federal funds. The most clear example is hospitals. At the National Center for Law and the Deaf, we have filed many complaints against hospitals that do not have TDDs. If they do not have a TDD for emergency purposes or for access to the hospital, you can bring a complaint against them. We have gotten judgments. Typically, we have not had to go to court because we win at the administrative level. Again, in that situation what we do is file the complaint with the agency administering the funds to the hospital, so it's the Department of Health and Human Services. If it was a program administered by the Department of Education, let's say a school, then you would file a*

complaint with the school, and yes, it has been done many times and very successfully. We encourage people to file those complaints.

Question [Steve Billotte]: Was there any mention in your request for standards for bilingual operators?

Answer: ***Not to date. As I say, this coalition is very fluid. That is something we can consider.***

Michael Hurst, AT&T

THE PROCESS OF ESTABLISHING STATE-MANDATED RELAY SERVICES

*Michael Hurst**

[Editors' Note: When this paper was written, Mr. Hurst was an attorney with the San Francisco law firm of Graham and James. Since then he has joined AT&T. The opinions set forth in this paper are not necessarily those of AT&T.]

This paper addresses issues involved in establishing an intrastate dual party relay service through a state legislative mandate. The fundamental characteristics of such a relay service are outlined and the roles of the state legislature, the state regulatory agency, the executive departments, local exchange carriers, interexchange carriers, as well as representatives of hearing impaired persons are examined.

Often the enactment of a new statute recognizing the need for a relay service is, in and of itself, a major victory for hearing impaired persons in any particular state. Nevertheless, such a statute is only the first step in the challenging and often frustrating process of developing the rules and regulations necessary to establish and operate a relay service. Even when that process is successfully completed and the relay service is up and operating, there remains the important ongoing process of reviewing the operation of the relay service and, when necessary, seeking the help of the appropriate state governmental entity to maintain its operation in the best interests of hearing impaired persons.

Maneuvering through this process will challenge organizations representing hearing impaired persons to develop new skills and draw on new resources. Among the most important of these skills and resources are those which will allow hearing impaired persons to understand and function effectively in the peculiar world of regulated telecommunications.

This world of regulated telecommunications has always been complex with its labyrinthine sets of rules and regulations. It has become increasingly complex as the Federal Communications Commission (FCC), federal courts, and state regulatory agencies have allowed greater degrees of competition in the areas formerly reserved for telecommunications monopolies. Thus, the regulatory arena often becomes a tangle of regulations overseen by regulatory agencies attempting to resolve the conflicting goals of maintaining the perceived benefits of regulation while pursuing the promised benefits of increased competition.

Understanding this conflicting set of goals and determining how the relay service fits into the development of this increasingly competitive telecommunications environment is probably the most important analysis required of hearing impaired persons if they are to be successful in expanding the availability of relay service throughout the nation.

Fundamental Characteristics of Dual Party Relay Service

The fundamental characteristic of a relay service, which colors every aspect of its establishment and operation, is that the cost of providing relay service is much higher than most people are capable of paying to use the relay service. The cost of a nine-minute call through the California state dual party relay is close to $6. A subsidy is required in order to provide such a high cost service and make it generally available to hearing impaired persons.

There are two reasons for the high cost per call. First, a relay service is highly labor intensive. An

*Michael Hurst, J.D., Attorney, AT&T, 795 Folsom Street, Room 670, San Francisco, CA 94107

operator must be on line before and during the entire communication. Operators' wages make up approximately 50% of the cost of a call. Second, it takes longer to communicate over a relay service than through direct communications, thus the equipment costs are spread over fewer individual calls.

The need for a subsidy creates special problems when attempting to implement a relay service through a regulatory process which is changing dramatically as telecommunications services become more competitive. As telecommunications utilities are confronted with more competition it becomes more and more difficult to obtain subsidies from any particular service to support a relay service. At the same time, state legislatures are unwilling to allow increased competition and the associated deregulation to occur if telecommunications services are not universally available. At least one feature of universal availability is that services are widely offered at affordable rates. Thus, a state legislature can, and has in at least California and Illinois, order a relay service established and impose a surcharge on other telecommunications services to fund the relay service, even if such action goes against the general trend of reducing cross-subsidization within the telecommunications industry.

State Legislature

The state legislature is in almost every instance the key institution in initiating a relay service. Every state legislature has the power to regulate business activities within its borders. The scope of this power is limited by the United States Constitution and federal law. One of the most significant limitations relating to the regulation of telecommunications utilities is that a state cannot regulate the telecommunications activities that cross state boundaries. Such services are classified as interstate and come under the jurisdiction of the FCC. Another important limitation is that a state legislature cannot confiscate a telecommunications utility's property without compensating the utility. These two constraints have a very important impact on how a state legislature may implement a relay service.

First, since the state legislature only has the power to regulate business activity within the state (intrastate), a state legislature cannot order a telecommunications carrier to establish a relay service which provides interstate long distance service. This is a serious barrier to implementing a fully operational relay service which provides service equal in quality and scope to that available to hearing persons. However, since the great majority of residential calls are placed intrastate, a relay service can be established on an intrastate basis first. The existence of that relay service may then provide leverage at the FCC to bring about interstate service.

The subsidy issue for relay service creates a problem with the second limitation--a utility's property cannot be confiscated without compensation. In short, a state legislature cannot order the utility to provide relay service at a loss to the utility. A subsidy from customers or taxpayers must be created in some form. This subsidy must be created with some care. At least two state legislatures, California and Illinois, have acted to order telecommunications carriers within their states to provide relay service and have authorized the utilities to collect a surcharge from all their customers to subsidize the relay service. In both states the issue of the magnitude of the surcharge has been revisited by the legislature at least once. It is clear that if that surcharge becomes politically unacceptable (by becoming too large) then support for relay service in those legislatures may be jeopardized.

Once the initial battle to establish a relay service is won within a particular state legislature, the most important long-term objective must be to keep the cost of the program under control and avoid continually returning to the legislature for increases in funding. This also can be avoided by drafting the enabling statute to allow for some flexibility in how much surcharge may be collected. Thus, the first battle in implementing a relay service is drafting a statute that provides for sufficient flexibility in the funding mechanism so that the program can respond to fluctuations in cost without returning time and again to the legislature.

The issues that motivate a state legislature to establish a relay service relate directly to the growing competition in the telecommunications industry. One argument often raised against allowing competition into the tightly controlled territory of telecommunications utilities is that such competition will make residential and rural service more expensive. The argument is that a significant subsidy flows from long distance services to local residential and rural services. As competition increases in the long distance market the magnitude of this subsidy will decrease.

Many legislators are concerned that increased competition not result in a lower quality or higher priced service to certain segments of their constituency. Hearing impaired persons have never had full access to the telecommunications network, and it is feared that increased competition would reduce the likelihood that

such access will develop. This is because it is even more difficult to generate a subsidy for relay service, as prices for telecommunications services are determined more by the market than by regulatory mandate. Thus, increased competition has provided an opportunity to hearing impaired persons to raise the possibility that if the legislature does not act now, it is unlikely that a relay service and full access for hearing impaired persons will ever come about.

State Regulatory Agency

The method universally chosen by state legislatures to regulate telecommunications utilities is to delegate authority to an agency or commission to accomplish the day-to-day task of regulation. These state regulatory agencies can do no more than the state legislature authorizes; they are "creatures of statute" and are restricted by the bounds of the enabling statute.

Nevertheless, such regulatory agencies are very powerful and are the most important agency in terms of establishing the actual operating parameters of a relay service. Generally, once the statute mandating the establishment of a relay service is effective, the burden of fleshing out the service rests entirely with the regulatory agency. Such an agency has several alternative courses of action available to it. It can:

- initiate a "rulemaking" proceeding and invite all interested parties to help develop the necessary rules and regulations under which a relay service will operate;
- order the utilities to come forward with proposals for the relay service and select from among those proposals; or
- provide combinations of the first two options.

Illinois is following, for the most part, option one. A final set of regulations is expected soon. California, on the other hand, has followed option two and has had an operational relay service for some number of months. Option one has the advantage that full participation by hearing impaired persons is possible in the initial development of the service. Option two, however, can be accomplished in a shorter period of time.

At least one state regulatory agency, New York's, has acted to implement a relay service without a specific legislative mandate. That agency has interpreted the existing New York law as granting the agency sufficient authority to order the local telecommunications utilities to implement an intrastate relay service and spread the cost of that service in the rates to all customers. Most state statutes which create the regulatory agency for that state have very broad language which could be interpreted as New York's agency has interpreted its statute. In fact, as relay service becomes better understood and as hearing impaired persons develop their organizing skills on this issue, more states may follow New York's example. This would short circuit the necessary run through the legislature for special enabling legislation.

Regardless of which route is taken to get to the state regulatory agency, at some point that agency is going to hold hearings or some form of public forum to debate how the relay service should be established and operated. These proceedings are very critical and also very difficult. The state agency will have before it the conflicting concerns of the industry and its various players--hearing impaired persons, the general body of ratepayers, state executive agencies, and its own staff. Understanding the fundamental nature of each of these parties' interests is the key to resolving the issues and eventually obtaining relay service.

Aside from this basic analysis of the differing interests involved in a proceeding to establish a relay service, there are several important tasks that hearing impaired persons must fulfill to be successful.

First and foremost, it is necessary that hearing impaired persons know the rules relevant to the proceeding that is followed in their state. If it is a rulemaking, there are specific rules that must be followed for each agency. If it is to be workshops or hearings or a combination of both, a different set of rules will apply. Every agency will have a published set of rules to guide such proceedings; the first step in working through an agency is to determine what procedure applies and what rules govern that procedure.

The second important task is to come to the proceeding prepared with a proposal. In almost every instance, state agency proceedings take on a life of their own. If hearing impaired persons come to the proceeding without a specific proposal, the entire proceeding will become focused on the proposal of those who come prepared. Now that several states have moved significantly through the process of establishing a relay service, being prepared with a proposal should not be a difficult task.

Third, and equally important, hearing impaired persons who are going to participate in a proceeding to establish a relay service must get to know the agency staff assigned to the proceeding. Often the staff position can tilt the balance between two conflicting positions in such a proceeding.

Fourth, it is important that hearing impaired persons build organizational support that can provide the legal and technical backup that is essential to presenting a professional case to a regulatory agency. Often a good lawyer or witness can help tip the scales in a close decision.

Executive Departments

State executive departments often intervene (officially participate) in proceedings before state regulatory agencies. Their level of participation and influence varies widely, but they can often be a significant resource for hearing impaired persons. For example, in Illinois the Illinois Public Counsel, the Illinois Attorney General, as well as the Department of Rehabilitation Services all participated in the rulemaking proceeding. Each of these agencies supported the positions adopted by the statewide task force representing hearing impaired persons. They also provided important logistic support in the Illinois proceeding.

However, often these executive departments and agencies have limited influence with the regulatory agency. The regulatory agency is an independent agency created by statute, and generally the governor, or any other state official, for that matter, has limited direct influence over the regulatory agency.

On the other hand, a state's governor may wield significant indirect influence with various members of the regulatory agency. Usually the members of the regulatory agency are nominated by the governor and appointed upon approval of one or more of the legislative branches. Thus, over time, a governor may place in control of the regulatory agency individuals with whom he or she shares a common point of view or political outlook. This is an indirect form of influence which can have a great impact on the general direction and policies of the regulatory agency. This area of influence is not one that should be relied upon in efforts to implement a relay service unless the state agency takes up a policy of opposing any relay service. A governor could have significant influence on reversing such a policy.

Local Exchange Carriers and Interexchange Carriers

The local exchange carriers and interexchange (long distance) carriers will bring considerable resources to a proceeding instituted to establish a relay service. Their interest will focus on preventing the relay service from placing their particular company at a competitive disadvantage. In all instances this means that the subsidy must be spread evenly among all the companies so as to avoid discriminating against any one company.

It also means that there may be some competition among various companies to provide the service because of the beneficial public relations it generates. An important concern that may not always be self-evident is that each company will seek to avoid any unnecessary interference in its ability to manage its own affairs. How this will play out in any particular state is extremely difficult to predict. No consistent position has developed among industry participants across all the states that are considering relay services.

Because of this lack of consensus in industry positions, hearing impaired persons should always start from a position that they are willing to negotiate. If hearing impaired persons come to these proceedings with a proposal in hand and a stated willingness to negotiate with all parties, then their objectives are very likely to receive serious consideration in those proceedings.

Nevertheless, industry participants have a significant advantage in these proceedings in that they can bring significant resources and experience before the regulatory agency. Having a carefully drafted proposal and avoiding unnecessary conflict with the industry participants is the best guide to conserving resources for the important issues.

Obviously, with all these players in the field, the name of the game is coalition-building. The more parties supporting a proposal, the more likely that proposal will succeed.

Conclusion

Implementing a relay service through a legislative mandate to a regulatory agency is a complicated and lengthy process. To succeed, hearing impaired persons must be capable of organizing a coalition which includes consumer representatives of hearing persons, members of the state legislature, and state executive agencies. These coalitions must be able to draw on legal and technical resources capable of assisting

hearing impaired persons in participating effectively in the intricate proceedings that are used to regulate telecommunications utilities.

Finally, these coalitions must be established for the long-term because establishing a relay service is only the first step. Hearing impaired persons will need to continue to go before the relevant state regulatory agency to review and modify, if necessary, the ongoing operation of the relay service.

QUESTION AND ANSWER

Question: I have been listening with great interest to what you said about the local exchange carriers setting up this relay system in Illinois. Perhaps we have the wrong idea at Bell South, but how were they able to get by the modified final judgment that barred us from changing content? In fact, in order to be of service in a relay system, we must change content; not the meaning, but the content as it is given to us.

Answer: *The modified final judgment is the settlement in the AT&T antitrust case that was decided by Judge Greene. Its result was that the regional operating companies be divested from AT&T. Bell South is one of the regional operating companies. One of the constraints that is placed on those companies is that they may not provide service across LATA boundaries–LATA means local transport area. That is usually a small area, like Chicago and the surrounding area; so, for example, the regional operating companies can't provide service from Chicago to Springfield, Illinois. [These companies may not change content of information going across their lines, which was part of the consent decree intended to keep these companies from entering the information services business.]*

Fortunately, in Illinois, no one raised the issue. We expected that they would, and we expected to have to address it, but they didn't. And so the rule was written without objection; no one raised it as a problem, and it will go into effect without that issue being addressed. One of the reasons they may not raise it is that relay service is going to be provided through a third-party organization, and they may see that as some protection. I don't see how, but they might.

Comment [Fred Weiner]: You made a point about informing the hearing public about the use of TDDs. I think that another segment of the population should be addressed, namely the hearing impaired population who don't know about TDDs. We have to educate people about TDDs through major television advertisements–not through closed captions, but through open captions so they can understand these things.

Question: I would like to know what form of advertising you have in your state for educating the hearing community about the relay services and the services that are provided for the hearing impaired.

Answer: *It is very limited for the hearing community. About the only information they get is the surcharge on their bill. Most people are not aware of it. Some people figure it out. My wife saw me working on all these cases and really didn't understand what it all meant until she got involved in it, and even then missed a lot of the points. There is a lot of education that needs to be done.*

Question [Joe Heil]: I think you raised a good point. I go back to my experience when I set up operator services for AT&T. We did a big publicity program, instruction booklets, and then for five or six years we never did anything more. There is a need for continuing, constant re-informing of not only the hearing public, but also the deaf community. There is a continuing need for training and education. We tend to treat it as a one-stop item in the planning and institution of a new system, then we forget about it. So I would add that ongoing, continuing education is needed.

Answer: *There is an additional point to add to that. We felt it very important that the focus be within a state, that we not try to impose this from the federal level down. The reason is this: The effort of trying to get a dual party relay within a state resulted in a coalition. The local leadership was built up and people got involved in the process within that state. Now they can do something [about continual education]. If you direct it from the federal level down, you wouldn't have that grassroots organizational ability to respond on an ongoing basis.*

Question [David Curioni]: Can you tell me which third-party [relay service provider] will provide service in Illinois, and how you selected that third-party?

Answer: *A not-for-profit organization has been selected for TDD distribution. They have been*

selected for overseeing the dual party relay system. That will consist of having people bid on becoming the service provider for the dual party relay. A bidder will be selected and then recommended to the Commission for its approval. The necessary contracts will be entered into. The not-for-profit organization will supervise the transfer of funds between the utilities and itself, and the service provider. The service provider could be anybody. Every five years that comes up for bid again, so every five years a new service provider could come into existence or the one that is currently in existence could provide the lowest bid and continue providing it. It could be anybody. It could be an interexchange carrier, it could be a not-for-profit organization–whoever can meet the standards in the rule and submit the lowest bid.

Pamela Ransom, Chicago Hearing Society

DUAL PARTY RELAY SERVICE: AN ANALYSIS OF FUNDING MECHANISMS

Pamela Ransom[*]

Persons with normal hearing may be unable to fully appreciate the pervasiveness of the telephone, both in the commercial transactions and personal contacts. The inability to use this instrument . . . is not only a practical disability but a constant source of dependency and personal frustration.[1]

The telephone is an integral part of our everyday lives, a critical link to the mainstream of our society. For more than 100 years since the telephone was invented, people with severe hearing impairments and people with speech impairments have been, in effect, "locked out" of the telecommunications network. However, this is changing. With the advent of state-mandated telecommunication devices for the deaf (TDD) distribution and dual party relay programs,[2] the telephone will finally be accessible to severely hearing impaired and speech impaired persons.[3]

This paper will present and analyze three alternatives to financing intrastate dual party relay services. These alternatives will be exemplified by programs either already established or being planned in the states of Arizona, California, Illinois, and New York.

This paper is structured so that each state is profiled individually. The profiles will provide the context in which the funding mechanisms operate. The history and actual approach to funding will then be outlined. In conclusion, financing models will be analyzed based on to what extent the models meet three major criteria: long-term financial stability; cost-effectiveness; and access to the telephone network equal to that of general customers.

We are in a period of experimentation in the development and operation of dual party relay services. Arizona, California, Illinois and New York have taken unique financial approaches to providing access to the telecommunications network through dual party relay services. The purpose of this paper is to raise questions and stimulate further thought and analysis, the ultimate goal being the evolution of an efficient and effective dual party relay service which will make the telephone accessible to people with severe hearing and severe speech impairments.

Arizona Relay Service Profile

Implementation Date: March, 1987.

Average Call Volume Per Month: 19,000/month (January, 1987 through June, 1988).

Budget: $48,843 average/month (January, 1987 through June, 1988); $102,000 average/month (projected January, 1989 through June, 1989).

Number of Relay Operators: As of August, 1988, 52 operators (23 full-time, 16 part-time, 13 temporary). Projected early 1989, 104 operators. Based on three shifts.

Funding Mechanism: At a rate of .4%, the monthly phone line service charge funds both TDD distribution and relay (effective July, 1988, H.B. 2082, Chapter 145, Sec. 42-1372.2).

[*]Pamela Ransom, Executive Director, Chicago Hearing Society, 10 West Jackson Boulevard, Chicago, IL 60604

General Service Description:

- The state is legally responsible for ensuring relay services.
- Relay service is available 24 hours a day, seven days a week.
- There is no charge to the relay user for intrastate calls.
- The state contracts with a not-for-profit agency to provide the relay service.
- A Merlin 3070 telephone system is used (presently at maximum capacity).
- Incoming 1-800 lines and outgoing WATS lines are used.
- Intra- and interstate calls are placed for relay users.
- There is no consumer advisory council. (However, one is being developed.)

Financing for the Arizona Relay Service:

Arizona's TDD distribution and dual party relay service programs were legislated by Arizona Senate Bill 1010.[4] This bill mandated that the Arizona Council for the Hearing Impaired (ACHI), a state agency, establish and administer both a statewide TDD distribution program and dual party relay service for severely hearing impaired and speech impaired persons. The Council was given the authority to develop program rules and procedures. (See Figure 1.)

Initial funding for the bill required that from June 30, 1985, through June 30, 1988, .2% of monthly phone line service charges would finance the aforementioned programs. It was estimated that this excise tax would generate revenues of approximately $45,000 per month. A Telecommunication Fund for the Deaf (an interest bearing account) was established to be administered by the state agency as the depository for the excise taxes used to finance the programs.

TDD distribution was the state's first program to become operational in July of 1986, to be followed by the establishment of the relay service in March of 1987. The ACHI contracted with a not-for-profit agency for the distribution of TDDs and the operation of the relay.

Since its inception, the relay service has experienced a steady increase in call volume. During the relay's first five months of operation the number of incoming calls increased from 7,100 to more than 11,200.[5] In response to the growing need, ACHI made the decision to continue expanding relay operator capacity.

It soon became evident that the monthly program costs were exceeding monthly revenues. In August of 1987, monthly relay expenses were approximately $43,000 and TDD distribution expenses averaged $14,000 per month, creating a $9,000 shortfall. It was projected that the programs would run out of money by June of 1988.[6] This financial crisis was reflected in the headlines of the *Arizona Council for the Hearing Impaired News Bulletin*, which read: "Relay Service Scheduled To Close."

In the spring of 1988, Senate Bill 1230 passed, increasing the excise tax to .4% of the monthly phone line service charge. It is anticipated that this increase will generate approximately $98,000 per month. If, however, the demand for service and relay operator capacity continues to escalate, consumers will be forced to continually go back to the Arizona legislature for increased funding in order to maintain the services.

California Relay Service Profile

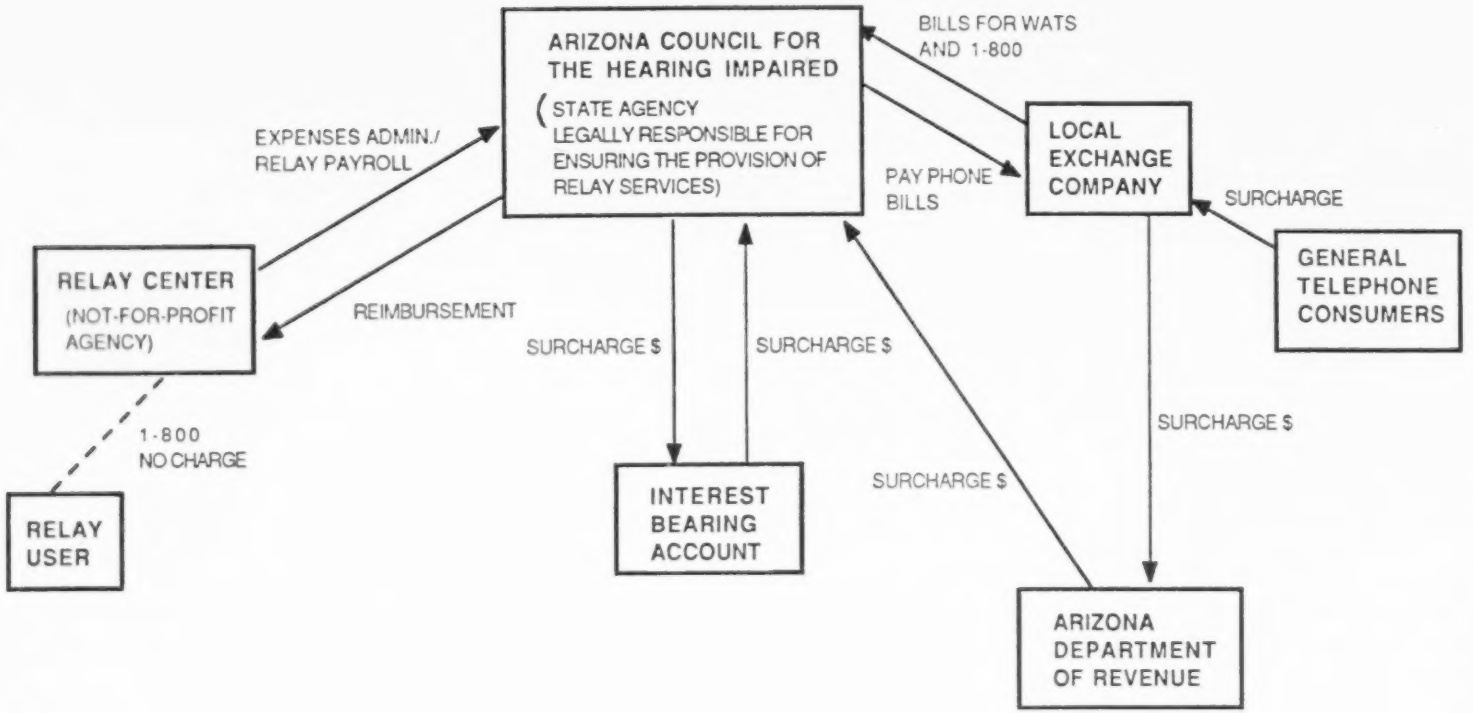
Implementation Date: January 1, 1987.

Average Call Volume Per Month: 50,000/month (January, 1987) increasing to 175,000/month (December, 1987).

Budget: $8,726,530 (January 1, 1987 through December 31, 1987).

Funding Mechanism: The Public Utility Commission ruled that on a temporary basis (October 1, 1988 through June 30, 1990) a charge of .5% of the total bill on all intrastate tariffed services will be collected to fund the programs. As of January 1, 1990, the charge will revert back to no more than ten cents per subscriber line. In addition to the aforementioned funding, revenues are generated from the relay user being billed from the call's point of origin directly to the point of termination. These user revenues are passed to the Trust Fund to help offset the operating expenses of the relay service.

ARIZONA RELAY SERVICE FUNDING FLOW CHART



General Service Description:

- Local exchange carriers (telephone companies) are legally responsible for ensuring that the relay service is provided.
- D.E.A.F. Trust (a not-for-profit corporation) administers the service.
- Relay service is available 24 hours a day, seven days a week.
- Relay service is provided by AT&T under contract.
- 1-800 and WATS lines are used.
- There is no consumer advisory council.
- Only intrastate calls are placed for relay users.
- AT&T System 85 is used.

Financing for the California Relay Service:

The California Relay Service (CRS) was established under the Public Utility Code Section 2881 by Senate Bill 244 chartered in 1983. The CRS is only one of a number of telecommunications access services provided in California. Initially, funding of a three-cent surcharge per subscriber line was established to fund all of the programs. (See Figure 2.)

On January 1, 1987, the CRS opened its doors. It was soon evident that actual relay usage would far exceed initial projections. It was projected that the D.E.A.F. Trust Fund would incur a deficit by mid-October, 1987, if the surcharge remained at the three-cent funding level.

As a result of the projected deficit, the Commission granted an emergency increase effective September 1, 1987. Resolution T-12043 increased the monthly surcharge for residential, business, foreign exchange, PBX, and semi-public service from three cents to ten cents, and increased the surcharge for Centrex and Airport Communication Service to one cent.

Effective January 1, 1988, Resolution T-12056 expanded the ten-cent surcharge to private line and WATS/800 services and increased the Centrex monthly surcharge to ten cents. The Commission expressed its concern that even these expanded revenues would not sufficiently fund the programs beyond June, 1988.

The California funding crisis prompted the Commission to initiate an inquiry regarding the "feasibility of implementing new funding sources and program reductions in the Deaf and Disabled Program."[7] The Commission began the review of these services in November, 1987. Informal workshops and formal proceedings have taken place since that time.

On July 8, 1988, the Commission issued an order which set forth the issues to be addressed by the expanded investigation. These issues included, but were not limited to, the following remarks: "Has there been fiscal or program mismanagement or abuse of the Trust Fund by the TA [Trust Administration]? What safeguards can and should be developed to eliminate any real or perceived mismanagement of the Trust? Should limitations be imposed on the use of the CRS to reduce costs to the Trust Fund and, if so, what types and to what extent?"[8]

In July, 1988, the Public Utility Commission, in Resolution T-13005, ordered that from October 1, 1988, through June 30, 1990, a charge of .5% of the total bill on all intrastate tariffed services be collected to fund California's telephone access programs. Then, effective July 1, 1990, the charge will revert back to a level of not more than ten cents per subscriber line.

Illinois Relay Service Profile

Projected Implementation Date: As soon as practicable, but no later than June 30, 1990.

Projected Call Volumes: 50,000/month (initial start-up), 100,000/month (after one year of operation).[9]

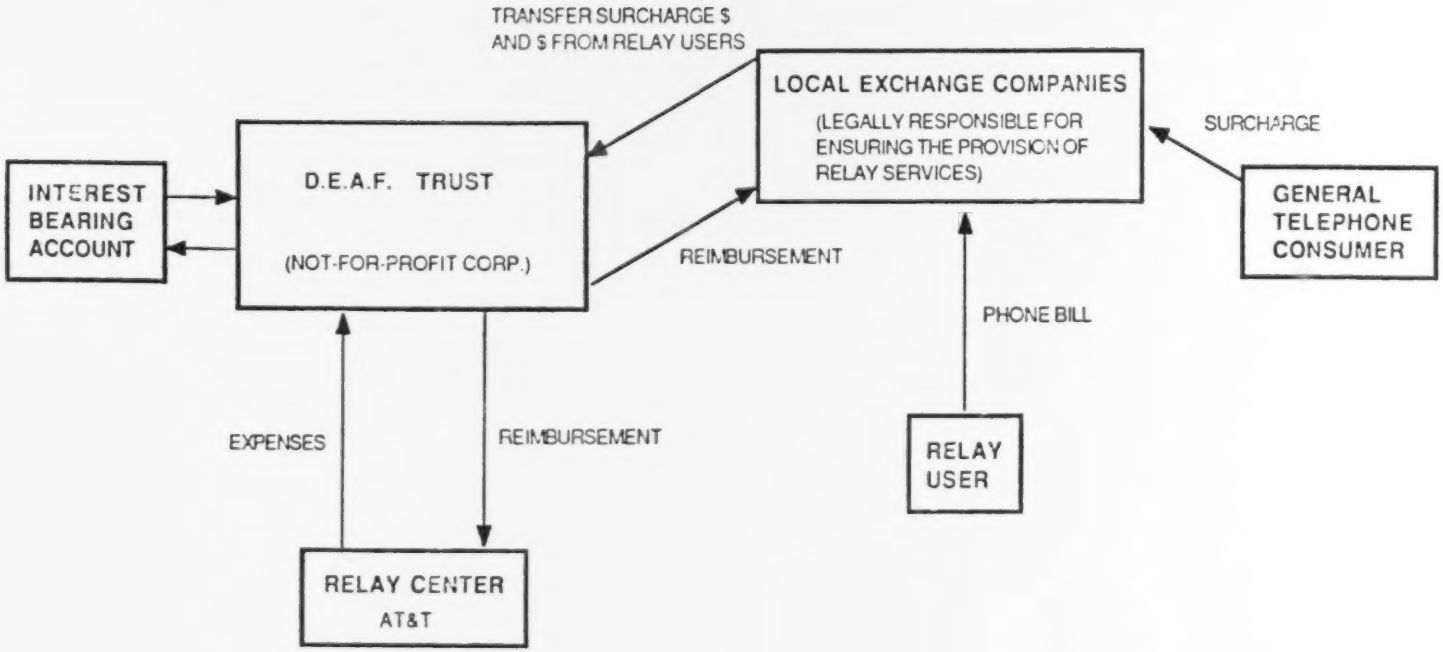
Budget: Based on 100,000 calls per month, the annual budget is projected to be $6,612,731.[10]

Projected Cost Per Subscriber Line Per Month: Based on an annual budget of $6,612,731 and 5,461,000 access lines in Illinois, it is projected that the cost per subscriber line will be approximately ten cents per month.

Projected Number of Relay Operators: Based on 100,000 calls per month, 175 relay operators are projected (this number does not include management, etc.).[11]

Funding Mechanism: "The Commission shall establish a rate recovery mechanism, authorizing charges in an amount to be determined by the Commission for each line of a subscriber to allow telecommunications

CALIFORNIA RELAY SERVICE
FUNDING FLOW CHART



carriers providing local exchange service to recover costs as they are incurred under this Section [for the TDD distribution and dual party relay service]."[12]

General Service Description:

- Local exchange carriers are legally responsible for ensuring that relay services are provided.
- Relay service will be available 24 hours a day, seven days a week.
- Relay users will be billed at the same rate which would apply if the call had been placed without the use of the relay.
- Only intrastate calls will be placed for relay users.
- Illinois Telephone Access Corporation (ITAC) shall, as the agent for the local exchange carriers, administer the relay service. (As of August 8, 1988, however, the Illinois Legislature's Joint Committee on Administrative Rules has filed an official objection to the Commerce Commission's authority to order ITAC to administer the relay service.)
- ITAC shall develop and circulate an RFP for the provision of relay services.
- A consumer advisory council has been established as a "watchdog" group. The council shall receive all ITAC and Commission filings, reports, or other information pertaining to TDD and relay services.

Financing for the Illinois Relay Service:

In 1985 the governor of the state of Illinois signed into law the Universal Telephone Protection Law. Section 13-703 of the law provides people with severe hearing impairments equal access to the telecommunications network through the establishment of a TDD distribution and statewide dual party relay service.

In December of 1985, the Illinois Commerce Commission (ICC) began proceedings to implement Section 13-703. The Commission considered the TDD distribution and dual party relay service in two phases. The TDD distribution was considered first. In December of 1987, Phase II of the proceeding was initiated to develop the rules for the dual party relay service. During the first several months of workshops and hearings it became evident to all parties that the three-cent surcharge would not be sufficient to fund the relay service.

In the spring legislative session the ICC introduced H.B. 3545. The Illinois Statewide Task Force for Hearing Impaired Persons (representing the interests of the hearing impaired community throughout the rule-making proceedings) supported this bill. The bill provides the Commission with the authority to set the surcharge rate based on the cost of the TDD distribution and relay services, and postponed the start-up date for the relay until June 30, 1990. Despite intense opposition from the telephone companies, the bill passed both Houses and has been signed by the governor.

This flexible method of funding will enable adequate financing without the need to continually return to the legislature for a change in surcharge levels. Along with this funding flexibility there must be incentives to ensure that services are provided cost effectively (i.e., filing of tariffs, contractual relationship between the local exchange carriers [LECs] and the relay service provider). The task force has advocated these safeguards during the rule-making proceedings; however, the Illinois Commerce Commission and the telephone companies have opposed them. There are presently few safeguards in the Illinois Rule to ensure that the relay services will be provided in the most cost-effective manner. (See Figure 3.)

New York Relay Service Profile

Implementation Date: January 1, 1989.

Projected Call Volume: 100,000/month (January 1, 1989 through December 31, 1989), 126,600/month (January 1, 1990 through December 31, 1990).

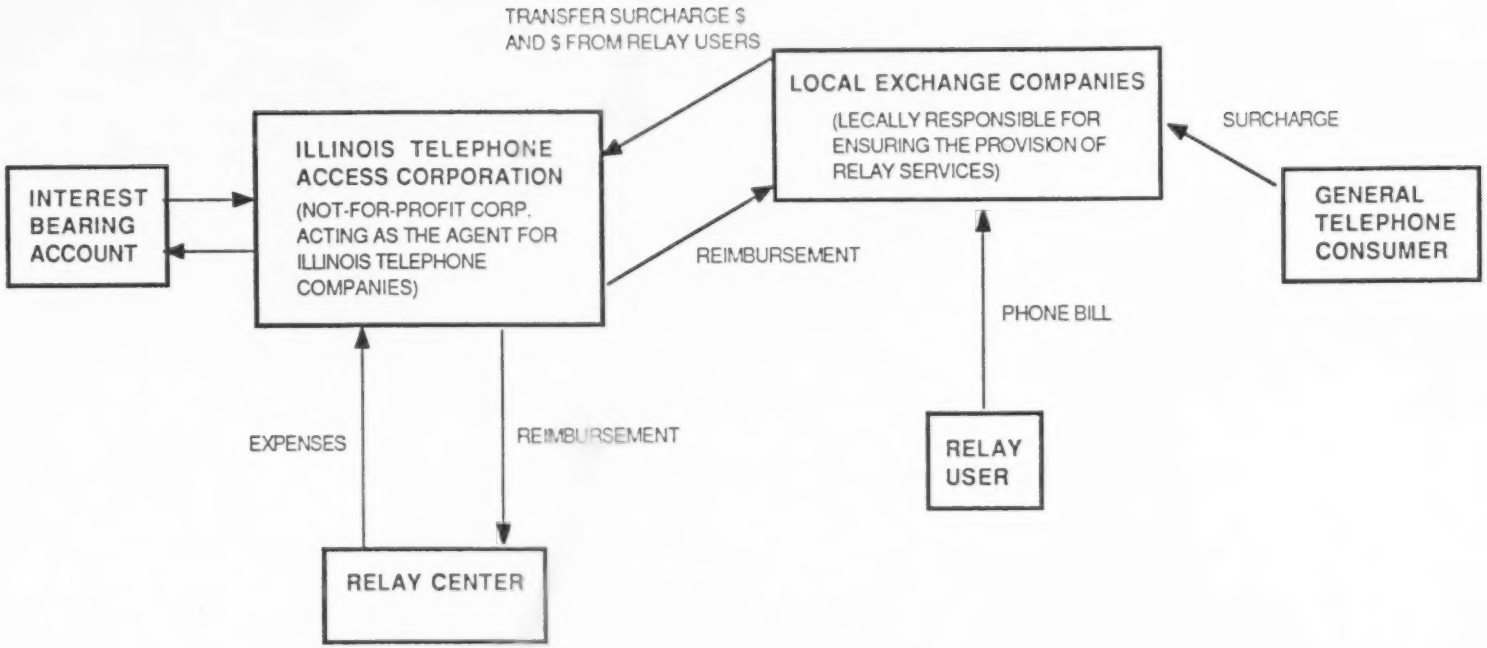
Projected Budget: $10.9 million (first year), $12.7 million (second year).

Projected Cost Per Access Line Per Month: Nine cents (first year), ten cents (second year).

Projected Number of Relay Operators: 163 attendants (first year), 172 attendants (second year), based on three shifts.

Funding Mechanism: Funding for the relay is treated

ILLINOIS RELAY SERVICE FUNDING FLOW CHART



as normal operating expenses to the local exchange companies (LECs). Relay service costs are recovered by two sources: (1) end user charges paid by users of the relay service and (2) assessments to the local exchange companies to be recovered from their general body of customers.

> *"Recovery shall be made by each local exchange company in the context of a formal tariff filing. The method of recovery, including rate structure, will be subject to Commission approval . . . The cost shall be assessed against the individual local exchange companies based on the ratio of each company's number of access lines to total statewide access lines for all local exchange companies."*

General Service Description:

- Relay service parameters should track the parameters of the existing telephone network as closely as reasonably achievable.
- The local exchange carriers are responsible for ensuring that the relay service is provided.
- The LECs contract with AT&T to provide relay services.
- Relay service is available 24 hours a day, seven days a week.
- Relay users are charged 50% of the tariffed rate which would apply if the call had been placed without the use of the relay.
- AT&T System 85 is used.
- An advisory board composed of telephone company representatives, Commission staff, hearing impaired consumers, and speech impaired consumers will be established.

Financing for the New York Relay Service:

In December of 1984, in response to advocates for the disabled community, the Commission initiated Case 28966 and issued a notice soliciting comments regarding the establishment of a statewide dual party relay service. The Commission received responses from 85 individuals and groups, and four telephone companies.

Commenters representing hearing impaired and speech impaired consumers were committed to providing relay services of the same quality and with the same procedural protection as telephone services for the general population. They proposed that the relay service should be operated by the telephone companies and that relay costs should be absorbed by all of the ratepayers. The telephone companies, on the other hand, proposed a relay service operated by a social or government agency. After a series of public hearings and further investigation, the Commission put the responsibility for ensuring provision of relay services squarely on the shoulders of the local exchange carriers.

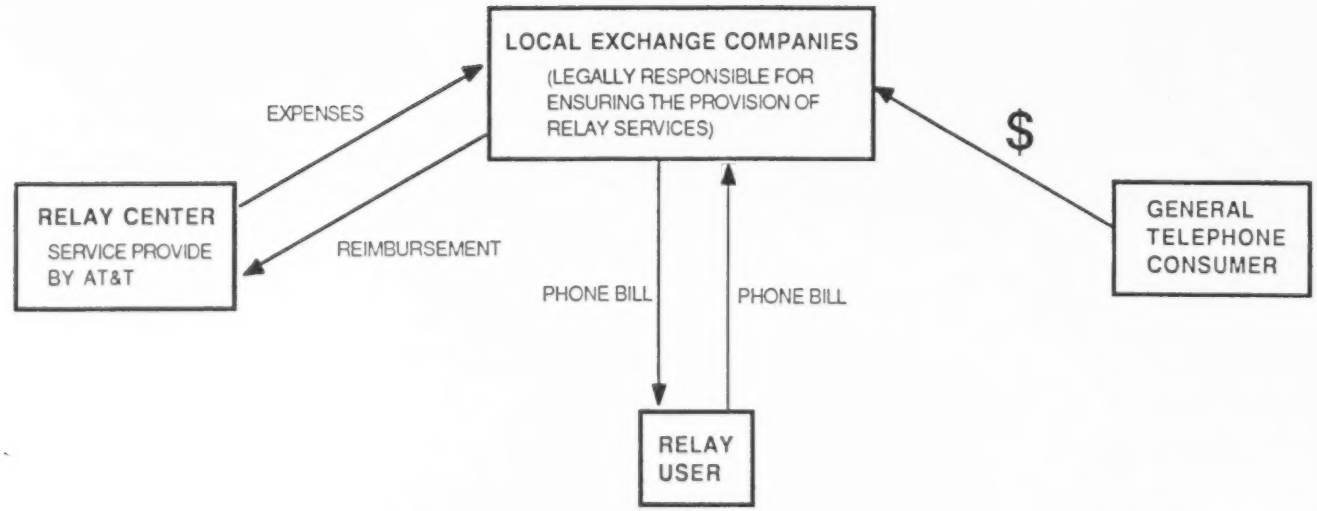
New York's philosophy of providing relay users with the same telecommunications quality and procedural protection as the general telephone consumers is reflected in its relay funding methodology. The relay service is treated as a normal operating expense for the local exchange carriers.[13] The Commission projects that the charge per access line per month will be approximately nine cents during the first year of operation.

Relay service costs are recovered from two sources: The person placing the relay call is billed 50% of the tariffed rate which would apply if the call had been placed without the use of the relay (this charge will not, however, pay for the total cost of the call); and the non-billable portion of the relay call is recovered at the discretion of the individual telephone companies from their general body of customers. Subsidies of this nature are not uncommon to promote universal telecommunications service. (See Figure 4.)

Analysis of Funding Alternatives

There are three basic approaches to funding relay services, which are exemplified by Arizona, California, Illinois, and New York. The first model is that of a capped surcharge or excise tax per subscriber line or per access line (Arizona and California). The second model is that of a flexible surcharge per subscriber line, which could be adjusted, depending on actual costs of services (Illinois). The third model is one which integrates the funding mechanism into the normal operating expenses of the telephone companies, distributing the relay cost across all rate payers (New York).

NEW YORK RELAY SERVICE FUNDING FLOW CHART



Three major criteria have been used to analyze the funding models:

- To what extent does the model promote long-term financial stability?
- To what extent does the model promote incentives for cost-effectiveness?
- To what extent does the model provide hearing impaired customers telephone network access equal to that of general telephone customers?

The Capped Funding Model

Of the three models, the capped funding model is the least effective in promoting long-term financial security, cost-effectiveness, and equal access to the telecommunications network for people with speech impairments and hearing impairments.

The capped funding model has not been able to respond to fluctuating program expenses due to escalating relay usage, and therefore it has created a funding crisis. When initial legislation was drafted, the amounts of capped charges were based on projected relay usage. Actual usage of the relay services far exceeded initial projections, however, thus creating a funding shortfall situation. These deficits have necessitated returning to the state legislatures for funding increases. Advocates in Arizona have returned to their legislature once. In California, legislative appeal has occurred numerous times and still there is no final solution to insufficient funding.

With each return to the legislature and each request to increase funding, the relay's future may be jeopardized. Continual requests for increased surcharge or excise tax rates to fund escalating relay costs could trigger an outcry from general telephone customers. This could lead to drastic cutbacks in relay services in order to decrease costs.

This has been evidenced by the Public Utility Commission's proceedings in California. One of the questions being asked is whether the use of the relay should be limited in order to reduce expenses. If services are limited, people with severe hearing impairments and people with speech impairments will be denied equal access to the telecommunications network. The capped funding model as it is presently structured does not promote long-term financial stability for dual party relay services.

This leads us to the second essential question: Does this funding model promote cost-effectiveness? In addition to the need for providing a flexible and sufficient source of funding, relay services must be cost-effective.

In California, a not-for-profit corporation, the D.E.A.F. Trust, was established to administer the TDD distribution and relay service. Surcharges collected by the telephone companies flow to the D.E.A.F. Trust Fund, to be utilized for program expenses. In California, the telephone companies are legally responsible to ensure the provision of relay services. They transfer funds to the D.E.A.F. Trust, the board of which is dominated by telephone company representatives, which then transfers funds to AT&T to provide the relay services. It appears that this methodology may not provide the most effective system of checks and balances by which to ensure cost-effectiveness.

In addition, two essential cost-monitoring mechanisms have been overlooked in California's funding process. There is no contractual relationship between the telephone companies (which are ultimately responsible for the relay service) and the D.E.A.F. Trust. Without a contractual relationship the local exchange carriers are insulating themselves from legal responsibility to provide the relay service. If there is no contract between the LECs and the D.E.A.F. Trust, there is no easily monitored mechanism by which the telephone companies can be held accountable for the transfer and usage of funds.

Secondly, the LECs are not required to file tariffs for relay services. Requiring the LECs to file tariffs would create incentives to provide services cost effectively, as the LECs would be held to those projections and could not abandon service. If relay service expenses exceeded the projected costs filed in the tariffs, the LECs would need permission from the Commission prior to increasing their recovery. The tariff filing procedure would enable the Commission to monitor relay service expenses just as it monitors the expenses of other telecommunications services.

Of the four states' relay services, Arizona's is the least costly to operate. ACHI contracts with a private not-for-profit social service agency to provide the relay service. It is estimated that Arizona's average cost per relay call is approximately $2.30, compared to California's average cost per call of approximately $6.

Although Arizona's relay system is presently less costly, there is one concern regarding long-range cost-effectiveness. It is questionable whether, with the advent of new technology, the Arizona relay would be able to adapt as quickly as a relay service provided by a telecommunications business. New technology such

as speech technology has great implications for significantly reducing future relay costs.

Although both of these relays provide service 24 hours a day, seven days a week, the services are still not equivalent to those telecommunications services enjoyed by general telephone users. Both Arizona and California have developed relay systems which are separate entities and not integrated into the existing telecommunications system. Rather than using existing telecommunications standards and financing and complaint procedures which ensure quality service and procedural protection for the general public, these states have developed their own standards and procedures.

These approaches do not provide the relay user with the same high quality of service and the same procedural protection as general telephone users. In the December 1987 Relay Audit, the Arizona auditor general expressed concern over the quality of relay services being provided. However, the most alarming example of this inequality is that the relay services in these two states could be terminated as a result of insufficient funding. Other telephone services cannot be terminated because the local exchange carriers have filed tariffs which do not allow them to abandon service.

The "Flexible" Funding Model

The flexible funding model, although it comes closer to promoting long-term financial stability and equal access to the telecommunications system, falls short of being the most effective model.

The Illinois Relay Service solves the problem of returning to the legislature for increased funding. H.B. 3545, which was passed in the spring, 1988, will enable the Illinois Commerce Commission to set the surcharge rate based upon the costs of the TDD distribution and relay service. This funding mechanism is flexible so that if relay program costs fluctuate, the subscriber line surcharge has the capability to fluctuate also. Therefore, there will not be a need in the future to return to the legislature for funding increases.

Although the Illinois Relay Service appears to solve this initial problem, it does not provide sufficient mechanisms which will ensure cost-effectiveness. Throughout the rule-making proceedings, the hearing impaired community, represented by the Public Interest Representatives (PIR),[14] advocated for the following cost-effectiveness mechanisms: to require the local exchange carriers to file tariffs for relay services with the Illinois Commerce Commission; to integrate the relay service into the already existing telecommunications system (in a manner similar to New York); and therefore not require the establishment of a separate not-for-profit corporation which would only add to administrative costs.

Although there was substantial opposition from the telephone companies, the proposed Ninth Interim Order requires each LEC to file a tariff providing descriptions and costs of relay service functions and setting forth the basis for rates which will be charged to the relay user. All filings with the Commission shall also be served on the TDD/Relay Advisory Council (a watchdog group representing the hearing impaired community). Both the Commission and the Advisory Council can more easily monitor costs through these tariff filings.

The PIR proposed integrating the relay service into the existing telecommunications network and opposed the establishment of a not-for-profit corporation to administer the relay service. It has been demonstrated by the New York Commission that the additional administrative cost of the not-for-profit corporation is not necessary for the management of the relay service. The PIR's proposal was not accepted and the proposed Ninth Interim Order stated that "the LECs shall . . . jointly administer the relay service through their joint agent, the ITAC [the not-for-profit Illinois Telephone Access Corporation]." The Illinois legislation's Joint Committee on Administrative Rules has, however, filed an objection questioning the Commission's legal authority to establish the ITAC to administer the relay services.

The Illinois model, like Arizona and California, does not provide a service which is equal in quality to that experienced by general telephone users. Illinois established its own funding procedures and less stringent quality of service standards rather than using procedures already established for general telephone customers.

Illinois relay users will, however, receive procedural protection similar to those of general telephone users. The telephone companies' requirement to file tariffs will make cost information accessible to the Advisory Council and will enable consumer input through Commission complaint and hearing procedures. The proposed Ninth Interim Order has stated that any disputes regarding the relay service shall be governed by the Illinois Administrative Code. These are the same procedural protection provided to general telephone users, and no less.

Illinois has taken steps to promote financial stability and equal procedural protection for relay consumers. These features are inadequate, however, unless the relay service is managed cost effectively. This flexible

funding model has the potential for promoting a runaway spending mentality without regard to cost containment. Only time will tell whether Illinois will be led down the same path as California, where hearings have been instituted to investigate program management.

The Integrated Funding Model

The integrated funding model, as compared to the capped and flexible models, appears to most effectively promote long-term financial stability, cost-effectiveness, and equality of telecommunications service for relay users.

This funding model treats the relay expenses as normal operating expenses of the local telephone companies. It integrates the relay expenses into the rate base of general telephone consumers rather than setting up an entirely new process. This is a flexible mechanism which avoids the problems of a capped funding model.

The integrated model has also put in place the procedures to promote cost-effectiveness. The local exchange carriers are required to file tariffs for relay services with the Commission. This is the same procedure which is used for all other telecommunications services. In addition to tariff filings, a contractual relationship will be established between the local exchange carriers and the relay service provider (AT&T).

The New York State Department of Public Service has, however, expressed concern regarding the cost-effectiveness of the relay service. "Although the direct costs of the system appear reasonable, A&F (Accounting and Financing) is concerned that the profit margin is high . . . We recommend that the Commission allow the LECs full recovery, but put them on notice that the Commission will expect them to develop lower cost alternatives or to introduce incentive mechanisms into the contract to reduce or control costs. . ."[15]

The New York Commission has stated that the relay service should track the parameters of the existing telephone network as closely as is reasonably achievable. The relay service utilizes existing telecommunications standards and procedures. This is in contrast to the other three states, which have developed totally separate systems to administer relay services. The New York LECs are required to file tariffs, contract with the relay service provider (AT&T), and use general telephone operators' service standards for relay operators.

The rate issues which are being addressed by New York relay users are the same fundamental ongoing issues addressed by general telephone customers. Hearing impaired and speech impaired persons addressing the same utilities issues as general telephone customers provide the opportunity to develop even stronger consumer coalitions to address common concerns.

Conclusion

This is a time of innovation and experimentation. Statewide dual party relay services have the great potential to bridge the telecommunications gap between hearing, hearing and speech impaired people. The funding mechanism which is chosen by each relay service will provide the underpinning for the actual provision of services. This choice may make the difference between a relay service which is integrated into regular telephone services for years to come or is a separate relay system which, in the end, may be abandoned because of escalating surcharges or excise taxes. Of the three funding models presented, the integrated model, as exemplified by New York, comes the closest to promoting financial stability, cost-effectiveness, and equal access to the telecommunications network.

Notes

1. A dual party relay service enables telephone communications between a hearing impaired person using a TDD and a hearing person without a TDD through the assistance of a relay operator. The relay operator translates the TDD-typed message into a verbal message for the hearing person and, in turn, translates the verbal message into a TDD-typed message for the TDD user.

2. H.R. Rep. No. 888, 97th Cong., 2nd Session 4 (1982) quoted from the FCC Comments regarding Interstate Dual Party Relay Service, August, 1988.

3. The following states are in the process of developing an intrastate dual party relay service: Arizona, California, Connecticut, Florida, Hawaii, Illinois, Kansas, Louisiana, Maine, Maryland, Massachusetts, Minnesota, Nevada, New Hampshire, New York, Oklahoma, Rhode Island, South Dakota, Texas, Utah, and Vermont.

4. S.B. 1010, Chapter 35, Title 36, Chapter 17.1 Article 1, Sec. 35--1947 and Sec. 42--1472.

5. "Performance Audit, Arizona Council for the Hearing Impaired, The Telecommunication Device for the Deaf Program, Auditor General, December, 1987, 87-13, p. 12.

6. Ibid. p.17.

7. Public Utilty Commission, Order Instituting Investigation, No. I. 87-11-031 filed Nov. 25, 1987.

8. Decision 88-07-033 July 8, 1988, Order Expanding Scope of Investigation. Before the Public Utility Commission of the state of California.

9. "Report of the Illinois Telephone Association on the Proposed Design of the Dual Party Relay System to Connect Deaf Persons with Persons of Normal Hearing," August 28, 1987, p. 3.

10. Ibid., p. 115.

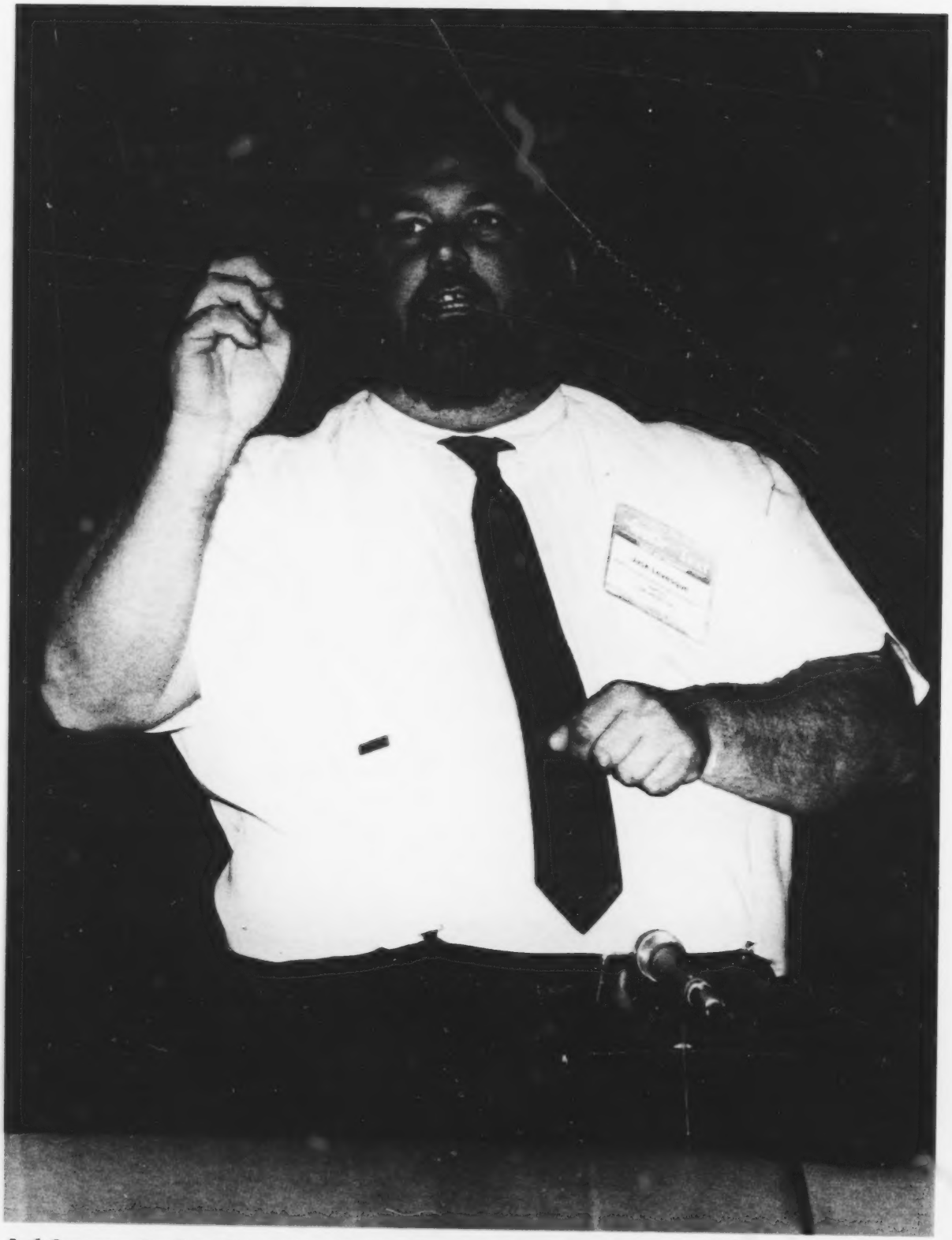
11. Ibid., p. 80.

12. HB 3545, etc., 85th General Assembly 1987 and 1988 Ch. 111 2/3, par. 13-703.

13. State of New York Public Service Commission Resolution by the Commission Case 26158, Resolution April 28, 1987, p. 8.

14. The Public Interest Representatives is composed of the following major parties: the Illinois Statewide Task Force for Hearing Impaired Persons; City of Chicago, Attorney General's Office; Department of Rehabilitation Services; Citizens Utility Board; the Chicago Hearing Society; and the Office of Public Counsel.

15. "Recommendation to the Commission from the Consumer Services Division and Communications Division of the State of New York Department of Public Services," April 5, 1988.



Jack Levesque, Deafness Counseling Advocacy and Referral Agency

PANEL: FINANCING MODELS IN STATE PROGRAMS*

PANEL:**

Pamela Ransom
Stuart Brackney
Jack Levesque
Kathy Woods

Pamela Ransom

There are two opposing policies which underlie the way a relay service is implemented. The relay service may be established as separate from the existing telecommunications network or it may be integrated into that already existing network. Relay services established as separate from the telecommunications network, exemplified by Arizona, California, and Illinois, have not been as effective in promoting long-term financial stability, cost-effectiveness, or access equal to that of general telephone consumers.

Integrating a relay service as much as possible into the existing telecommunications network is exemplified by the New York relay system. It is this approach which has the greater potential for long-term financial stability, cost-effectiveness, and service which is equal to that of the general telephone customer in terms of equal procedural protection and equal standards of service.

Our panelists will present alternatives and stimulate discussion and debate, which will hopefully promote the evolution of a stable cost-effective relay service. We will specifically focus on the financing alternatives for a dual party relay service.

There are three basic approaches to financing relay services. The first is a fixed or capped surcharge model. The second is a flexible surcharge model, and the third is an integrated funding model. In both Arizona and California, the legislators have established a cap on the surcharge or excise tax that is collected per subscriber line or per access line. In Illinois, initial legislation was established with the capped surcharge; however, that was amended this past session so that the Commerce Commission in Illinois can set the telephone subscriber surcharge rate based on the costs of the actual TDD and relay service program. So this model is a more flexible one.

New York's philosophy is really the integrated model. Its philosophy from the beginning has been to develop a relay service which tracks the parameters of the existing telecommunications network as closely as is reasonably achievable. This funding model treats the relay expenses as normal operating expenses of the

* This is a transcript of a panel presented at the conference. Because the conference was captioned, the text could be saved and edited.

** Pamela Ransom, Chicago Hearing Society--Chicago, Illinois
Stuart Brackney, Arizona Council for the Hearing Impaired--Phoenix, Arizona
Jack Levesque, Deafness Counseling Advocacy and Referral Agency/California D.E.A.F. Trust Fund--San Leandro, California
Kathy Woods, New York State Department of Public Service--Albany, New York

local telephone companies. It integrates the expenses into the rate base of the general telephone consumers.

Each panelist has been asked to describe his or her state's relay service, discuss the mechanics and the financing approaches of their services, and then give you an idea as to what they see as the strengths and weaknesses of the financing approaches that their states have taken. Each panelist is a relay expert in his or her state, and they will be able to provide you, I think, with a very unique approach and unique perspective.

Jack Levesque

I have a responsibility to explain the funding in California. I also must try not to be biased in my talk about the funding. In 1982 and 1983, there was a lot of discussion in California about continuing the distribution of TDDs. In Sacramento, we met to discuss whether we should continue distributing TDDs because we had already disseminated about 15,000 TDDs in California. Some people felt that now was the time for a relay telephone service. Some others felt that we should distribute TDDs to employers, families and friends; so after some discussion, we came to the agreement that we would focus on the TDD relay service, with the understanding that none of us would oppose that bill. We had an agreement that some of us would not oppose the bill because of the politics in the community related to who should be providing the service--that is, social service agencies or a telephone company. At that time, we expected to talk with Pacific Bell in California. For a few years we discussed the issues; the governor signed the bill in 1983, with the relay service to begin in 1986.

AT&T won the contract to provide the services. The local telephone companies agreed to allow Pacific Bell to collect the money monthly. Pacific Bell turns the money over to the D.E.A.F. Trust, where it is put into an interest-bearing account at the Bank of America. D.E.A.F. Trust is responsible for monitoring how the money is collected and disbursed, not how the telephone companies run the programs. This may change in the future, but I am here to talk about the present system.

The D.E.A.F. Trust receives three cents from each subscriber's phone bill; before, it was ten cents but it has been reduced to three cents. Keep in mind that this revenue covers three areas: TDD distribution, equipment for handicapped persons, and TDD telephone relay service. All three are under one charge because at that time, in 1983, there was a large amount of money accumulated, and they decided to add other programs to the initial [TDD distribution] one. Whether or not that was wise remains to be seen. We did have one problem: The term "deaf" appears on the phone bill. I wish we had never put that term in, because it gave a negative picture to the people who were paying their monthly bills; but that's life.

Now I'd like to talk about funding. I'd like to talk about the money, how much we earned, and how it is spent. We have approximately $20 million for three programs--the TDD distribution program, the TDD relay service, and the handicapped devices distribution program. The call volume for the relay program is now around the $250,000 mark per month. You have heard about the funding problems in California. This is due to the demand by deaf and hearing users of the TDD relay service. We are not in the hole because of problems, but mostly because the predictions of usage have been surpassed. It was forecasted that 50,000 calls a month would be the average. It was five times more than that in reality. This shows that deaf people need this service. The legislature and the Public Utilities Commission have instituted a temporary measure of collecting one-half of 1% per month on the customer's monthly phone bill until next year. They want to study the problem until they find a way to resolve the funding situation in a fair way. The relay service covers more than 120 operators who handle the phone calls, more than ten managers to supervise the system, a site in Woodland Hills, and all other expenses related to running a business. Some figures show that the average call for relay runs to about $7.50 per call. This is a marvelous system; let me share some of the different perspectives.

We have a situation that people need to understand. Congressman Major Owens mentioned this morning that the deaf community needs to advocate for the services. AT&T, which provides services, has a role to provide that service. They have to work together to make sure that the service is provided. There are a lot of communication problems in the deaf community itself because they are not very good at speaking up or sharing their concerns with the telephone company. The telephone companies themselves want to hear the problems, but the deaf people don't speak up. So the telephone company thinks everything is fine.

At the same time, I'm not always sure where AT&T is coming from. Let me give two or three examples to

show AT&T--two or three examples from the deaf side, to be fair. I went on a camping trip with fifteen deaf people one weekend. I decided to talk about the California Relay Service. I sat down with them and asked them what they thought of the service. Everyone said, "Oh, it's fine." They loved it. "Twenty four hours a day, seven days a week--wonderful." I asked if there were any problems. "No," came the resounding answer.

So I explained what happened to me on the phone. I put the phone on the hook, and I started typing and waited and waited. They said, "Oh, I'm used to that. I have had to wait all my life and I have had to be patient." But I call that a problem. I am concerned. Why did they have to wait? "Did you find out why you had to wait?" I asked. They said, "No, I'm used to it." They said, "Sometimes it is busy." I said, "You don't call that a problem?" They said, "No, I'm used to it." People are inclined not to call those things problems while the telephone company is waiting to hear any problems or concerns that people have.

A few people speak out, but many don't. There are some who have problems with operators, and deaf people accept those as normal. They said, "Oh, they're hearing. I'm deaf. Because they're hearing, they know more." They're used to that. We need to put a stop to it. We need to educate our community. We have that responsibility to teach them that if they don't speak out, things will not change. Things will not improve.

So on the AT&T side of the coin, let me give you an example. I understand that yesterday the telephone company filed a petition with the FCC. In California, a group of people met to discuss several issues. One issue was voice carryover. This telephone service is not only for deaf people, you know. It's for all different kinds of hearing impaired people, hard of hearing people, people who were deafened, people who were born deaf, people who have lost their voice. Some people can talk, some people can hear and not talk. Some people can talk and not hear, so the voice carryover allows choices. It enables people who have a variety of different problems to use the telephone. If they want to talk into the phone and receive a typed message back; or if some other [vocally impaired] people may want to hear, so that cuts down on time. It shortens the length of a long distance call. My understanding is that the group met and everything seemed to be all right. They needed to investigate the cost itself and everything, but AT&T opposed that without any of us knowing. I don't like that. I think we need to be more open about those things. I think we need to communicate, not hide things under the table. Deaf people are very gullible. We shouldn't be taken advantage of. We need to cooperate more.

Another example: We met several times last summer in San Francisco about the settlement hearings to resolve how to improve services. There was a lawyer there who represented a telephone company. He spent all week there. His number one role was to make sure that no one touched the budget. I didn't feel that was an action of good faith of us working together. When it was over, the lawyer sat down and wanted to talk and said, "Let's contact each other and talk more later." Remember, during that whole week they [discussed] relay service; and the lawyer said, "You know, I want to contact you, but how?" I gave him my phone number, and the lawyer said, "How can I contact you? I don't understand. Should I have someone interpret for you or..." I said, "I spent a whole week here with you and you still don't understand the relay system yet? Something is not right." So we need more partnership and more cooperation.

Stuart Brackney

Actually, I can do this really quickly. Arizona is the land of the six shooter. They still wear guns on their hips. Here is the explanation of the program's history: We just took the money and ran. I'm only joking. This is not true. This is not true.

I would like to cover a different approach, the one that was used in Arizona. You need to understand the political atmosphere--what you can and can't do, and what you would like to try to accomplish. We approached the state legislature, which had an interest in relay services. We were unsuccessful with the phone company the first year with a piece of legislation that would have created funding. We went back and got the phone company to reevaluate its posture as it related to relay services. I won't get into the issue of whether it is a telephone service or a social service. The point is we went back with a bill. The bill ends up charging everyone's phone bill. Here is a critical point. I think it is applicable to what you will hear later about New York. We did not want a tax or a surcharge on residents only. We felt that businesses would reap the benefit of being able to receive business inquiries from John Doe deaf, John Doe speech impaired, so the tax that we applied in Arizona was one that was across the board--all businesses, all residents.

It was a formula tax. Some of you know of states that have taxes designated in a penny amount. Ours is a formula. It started out as two-tenths of 1% of the base charge paid per customer line. I'm not a telephone man so bear with me on some of my telephone phraseology. It ended up being two cents a month per residential customer. The state of Arizona had all the phone companies collecting that money. The phone companies have collected the money. They give it to the Department of Revenue. That's our state tax collector. He, in turn, gives it to my state agency.

As Jack was saying, we watched the program in California; we watched the TDD distribution program, and then we watched the beginning of relay services. We, in our statute, said that the money will be used for both. So we used one statute to say the purpose of tax dollars will be to do both--provide TDDs and provide relay service. We chose to give out TDDs first. During the first year, you have a rule-writing process. So we ended up with money being collected by phone companies, given to the tax collector, who gave it to me; I turn around and put that money into an interest-bearing account, which you will find most state agencies or most states have. Take their general fund, the annual taxes you pay. They just don't sit there, they earn interest. We took the TDD money and put it into an interest-bearing account while we were writing that rule on how the relay will be run and how the TDDs will be distributed. That was a full year. It took us a full year, and we're talking about a lot of community participation. The funding money, therefore, is building up. We then began distribution of TDDs.

We had a problem in Arizona, and I don't recommend this approach to everyone. The problem was that we live in a six-shooter land, pickup trucks and rifle racks, cactus, and lots of heat. We also live in a state that we are proud to say is the home of Barry Goldwater. I have a super conservative legislature. In using the legislative approach, we ended up with what was called a three-year program. After the third year of the program (they use this term in state government), the program will "sunset." They don't say, "The program will die." They have this term that says it will just pass into the sunset. We said, "Fine."

The first year we were writing rules as we were collecting the cash. The second year we began distribution of TDDs, and then the third year we started relay. Interestingly enough, when you hear some of the chronologies of other states, we're talking somewhere into the third and fourth year of negotiations and trying to resolve issues. That's a lot of time. Consumers, as Jack pointed out, are not only deaf people, but they are speech impaired people and families. They are frustrated with the amount of time required for public hearings and filing of dockets, etc. We were able, through this approach, not to use the Arizona Corporation Commission (in another state, it might be called the Public Utility Commission). Instead, we put a bid on the street saying, "Excuse me, who wants to distribute TDDs according to these rules? Send us a bid to our RFP."

We got a nonprofit organization to distribute TDDs, a nonprofit organization that was familiar with the deaf community and was located in the two major communities, Tucson and Phoenix. We then got into relay services, and we have a funding problem that everybody, including California, is confronted with. The biggest cost for relay is what you pay your operators. The operators are your biggest cost, so we awarded a contract for a relay service to a nonprofit group that is paying fewer dollars for their relay operators compared to, let's say, larger companies/corporations/telephone utilities. So the cost for us to show that the service was needed, was low. And we got the service started a lot quicker.

What is the downside to this? Well, the downside is that our three years were almost up. We hurried up and got a state audit of the relay service, and here is what they told us. (I love it when another state agency tells me what I have been telling them for a long time.) One, relay service is needed. Two, it should be expanded. Three, it should continue receiving funding. Four, the funding should be increased to meet caller demand. I felt like a prophet. I said, "I could have told you that, but I would rather you tell me that because now I will take your report to the state legislature and say, 'You know that law that is going to sunset? Well, here is the Auditor General's bill, and here is the bill to continue the program and to increase the tax formula again from two cents to four cents.'" It passed, not because I said it would, but because the auditor general reviewed the program and said it is needed: "Continue it. Increase it, and by the way, you need some additional revenue."

The negative side of that program is you don't want to be stuck in the scenario of going back again and again to the legislature for funding increases. We have a joint legislative tax committee. They decide the taxes on your property; they sit down and say, "You know what we need to do? We need to raise property taxes." [Instead of a capped rate] we could have given them

[the joint tax committee] legislation to increase our telephone tax, if you will, as the needs dictated. But I was advised by the key legislative leaders that they don't meet very often. It's not a popular topic. You may not want to do it that way. See if you can hang in there with a cap.

In March of 1987, we started out with about 10,000 calls a month. A year later now, we are doing 22,000 calls a month. August of this year, we are doing 27,000 calls a month. My definition of a call is not the number of calls that come in. It's the number of calls that go out because we don't have a limitation on consecutive calls. That's a lot of calls. If I need to hire more relay operators, the state constitution says, "Stu, you cannot incur a bill for money you don't have in the bank." That is the rule for all good businessmen and also the rule for Arizona. I cannot just hope we will get new money. It is fixed money. The problem of my approach in Arizona is that we have a fixed income, and I have to get the biggest bang for the buck by using a nonprofit organization which pays a relay operator less bucks.

The point I would like to make is, with all the technology that you get for a relay service, the relay operator will make or break the service for you. And so if you are paying nickels and dimes, as everyone in this room knows, you are going to get pennies back. You pay for what you get or you get what you pay for. The rule is, find out what an operator gets in your town to start figuring out costs. Find out what the phone company is paying an operator. Go to your local labor office and find out what a standard pay range for a switchboard operator is. We have ten duty stations in Arizona that process 27,000 calls a month. Some of this is in the report. We started in 1987; 10,000 calls a month, as I mentioned. We're now up to 27,000 calls a month. People love the service.

Compare Arizona and California for a split second--$48,000 a month is my operational costs. That is going up. I am now paying $62,000 a month to run relay services. It is costing me $2.30 a call. Some people out there will hate to hear that number. Jack's number was in the $6 range. People hate to hear that number but don't let them snowball you. Why $2.30 a call when here in Washington, D.C. it is 20 cents for a telephone call? That's the way the general public does their comparison analysis between cost of relay call and cost of me just using a pay phone. They say, "Why are we paying $2.30?" Everyone in the room knows the answer. You are involving a relay operator, electricity, and overhead and telephone equipment.

I would caution you not to be shy, whichever funding approach you use. I would hope you use [Arizona's] as an example to consider as you lead into the New York approach. I find the New York approach stimulating, because I can't continue to keep up with growth using a nonprofit. I love [nonprofit relay services]. They provide me a quality service. The deaf community loves them. The hearing impaired love them. The deaf-blind love them. The point is we will not ever be able to keep up with growth for two reasons. One, we are not a phone company and two, we don't have the flexible revenue base to look to.

The concern I have on setting up relay services is twofold: If we are going to start a program as we did in Arizona, I knew that we could do it for two cents a month. There were some legislators who said, "Stu, that is not very much money." I said, "Let me start small and build up." Telephone people, regulators and super-duper consumers say, "Stu, we want equitable service at the outset." I say, "You know, I wish I could, like a magician, create equitable service at the outset." But there was a time in Arizona where the political environment said, "You can get something through now. If you can make it work, do it now." We did it.

Where does this leave me? There is another approach I find more appropriate for Arizona now that I have established a definition of the need, a volume of the need, a rate of growth, and a cost factor on what it is costing me with a nonprofit to run the service. Then I find out about New York. In New York, they are opting for yet a different approach that I say, "Well, let me now watch New York." See, I'm a thief. I'm sorry, but I am. I steal from Jack in California as I watch what they do, and that's, I hope, part of the purpose of this conference. Now I'm in operation, but I know that I cannot in the long-term provide equitable services for all. So now I look to Ms. Woods, New York, and what they have planned for the future and hopefully, as I see their success become a reality, I will use that approach.

Pamela Ransom

I am happy to be presenting the Illinois approach, which is really the flexible funding approach. Illinois approached this a little bit differently. We began the process and soon realized during the workshops and rule-making proceedings that the three cents that we had initially included in the legislation, which was a capped limited surcharge, was not going to be

sufficient to fund both the relay service and also TDD distribution.

The past two years have been long, very involved, and very complicated--I think Michael Hurst said it well when he said, "the peculiar world of telecommunications." I think we learned more about it than we wanted to know. But I think the end result for the hearing impaired community in Illinois will be a very, very positive one. We will have not only TDDs distributed, and a relay service, but maybe, more importantly, we will have developed a coalition of deaf consumers, hard of hearing consumers, and hearing consumers who have worked together to develop quality relay and TDD distribution services. I think throughout the presentations, you have heard the recurring theme that the coalition, in the end, is really the important result out of all of these proceedings. This is the group that's going to be able to evaluate and make sure that the quality is maintained.

Although the flexible funding model comes closer to promoting long-term financial stability, it still, I believe, falls short of the most effective model. The Illinois approach solves the problem of having to return to the legislature for increased funding; a bill which was just passed this past spring will enable the Illinois Commerce Commission to set the surcharge rate based upon what it actually costs to provide the TDD and relay services. This funding mechanism is flexible, so that if the relay program costs go up and fluctuate, the subscriber line surcharge also will have the capability of doing that. Therefore, we won't have to go back to the legislature for increases.

Although Illinois appears to have solved this initial problem, it doesn't provide sufficient mechanisms which will ensure cost-effectiveness. We all know that, really, [cost-effectiveness is] the basic issue. If we can't contain our costs, the ability to go back to the legislature for additional money is totally worthless.

The hearing impaired community was represented by a coalition of deaf and hard of hearing groups, the city of Chicago, Department of Rehabilitation Services, and Office of the Attorney General [Public Interest Representatives]. We advocated for the following cost-effective mechanisms. We wanted to require the local exchange carriers to file tariffs for relay services with the Illinois Commerce Commission. And we were proposing that the service be integrated into the already existing telecommunications system, in a manner similar to New York's proposed program. Therefore, we would not be requiring the establishment of the separate not-for-profit entity [for administration of the relay services], which in Illinois is being called the Illinois Telephone Access Corporation. We learned from New York that there was no need to set up this additional layer of bureaucracy, which is only going to cost the program more money.

Although there was substantial opposition from the telephone companies, the Ninth Interim Order has been filed by the commission. It provides descriptions and the costs of the relay services, and [is the] basis for surcharge rates which they charge to the telephone subscribers. All the filings with the commission shall also be served on the TDD Advisory Council. This is a consumer group which serves as a watchdog group to ensure quality services and to ensure that the services are provided according to the rule. Both the commission and the advisory council will be able to more easily monitor the costs through these tariff filings. I think it was also mentioned earlier that, as a result of the tariff filings, the local exchange carriers will not be able to abandon this service.

The Public Interest Representatives proposed integrating the relay service into the existing telecommunications network and opposed, as I mentioned, the establishment of this not-for-profit corporation. However, our proposal was not accepted, and the ITAC, or Illinois Telephone Access Corporation, will be acting as the agent for the local exchange carriers for the administration of the relay services.

The Illinois model, like Arizona's and California's, does not provide a service which is equal in quality to that which is experienced by general telephone customers. The standards of service and funding procedures for the relay service will not be the same as those standards and procedures used for general telephone customers. Unfortunately, it appears as if the standards for relay service will be less stringent than those required of general telephone operators. The Illinois relay users will, however, receive similar procedural protection as those of the general telephone users. The telephone companies, as I mentioned, will be required to file tariffs with the Illinois Commerce Commission; that information will be made accessible to the advisory council, and will enable consumer input through complaint procedures.

Illinois has taken steps to promote financial stability and equal procedural protection for relay customers. We don't believe these features are adequate, however, unless the relay service is managed cost effectively. This flexible funding model has the potential for promoting a "runaway spending" mentality without

regard to cost containment. If you know you have a large amount of money, and you know that it can fluctuate with the cost of a service, unless the program is very closely monitored, there can be that feeling, "Well, the money is there, let's spend it."

Unfortunately, that sentiment has been voiced. We feel that we have set in place a number of safety mechanisms--the tariffs, the advisory council. We tried in Illinois to bring the relay service as close as we could to the telephone companies' regular services. But I think that you will see with our next presenter's funding model that New York has come even closer to actually integrating the relay service into the already existing telecommunications network, which I believe in the long-run will provide the most stable and the most cost-effective and equal service to relay users as that which the general telephone customer enjoys.

Kathy Woods

I feel in a funny position at this point. Everyone has been talking about New York. I always feel as if I should take off my suit jacket and have a big S on my shirt and a cape, but as soon as I think of that I'm reminded of the bumper sticker I saw in Vermont not long ago which said, "I'm from Vermont, and we don't care how they do things in New York."

Let me give you a brief historical perspective of the relay service as it pertains to New York state. It began in March of 1984 when the state advocate for the disabled, Dr. Frances Berko wrote to the chairman of the Commission and asked what help the Commission could offer in what she termed a priority item of the Empire State Association of the Deaf and the New York Society of the Deaf, which was the establishment of a statewide relay service. The Commission, whose powers are very, very broad, determined that it could institute a proceeding; but before doing so, the Commission wanted to send out a notice soliciting comments to see what sort of response we would get, what sort of interest there was in the community. The notice soliciting comments went out, and it should come as no surprise to you that we received responses that ranged from "We think this is an unnecessary service" to responses that said, "This is the most important thing the Commission could ever do." With regard to the specific questions we asked--who should operate the service, how should it be funded, and what system would be best?--there was no unanimous response. We received a variety of answers.

However, the Commission, at this point in time, decided not to abandon the project. That was because we had a lot of push behind us from such individuals as Paul Taylor from the National Technical Institute for the Deaf, the Monroe County Association for the Hearing Impaired, and others representing deaf and hearing impaired consumers in New York state. And with their help, we once again went out soliciting comments, except this time the Commission did so under a Notice of Proposed Rulemaking. We asked questions. We wanted to see if perhaps the second time around we could gather some consensus regarding who should operate this service and how it should be funded; but once again, we didn't gather anything that was unanimous. Some people thought such a service should come from tax revenues. Others suggested a surcharge. Some people thought the telephone company should run the service. Others thought a human service agency experienced in dealing with the deaf and hearing impaired should run the service.

At this juncture, however, I think it's important to note what the Commission of New York state did, because what it ultimately did was make two very important findings. First of all, it determined that the relay service is part of the basic service obligation of the local telephone companies. Second, it determined that telephone service should be comparable to that provided to the hearing community. Now, if we keep those two things in mind, then everything else that the Commission did afterward follows in order. For instance, the Commission established standards. One of the standards was that the service should run 24 hours a day, seven days a week. Another standard that the Commission determined was that the entity operating the relay service should be one entity, with experience in telecommunications. This was a very important finding.

Now, I should note here that our rules said that the local telephone companies were responsible for the provision of a relay service. In New York, we were very, very fortunate because AT&T, in our Notice of Proposed Rulemaking, had responded and said it did have an interest in running a relay service in New York. So the Commission took AT&T and the local exchange companies and said, "Since AT&T has offered," (and, I might add, AT&T was the only entity that offered to operate this service in New York state) "the local exchange companies, at a very minimum, should sit down and discuss with AT&T what kind of system it is proposing." Ultimately, we had a series of contractual meetings between the local exchange companies and AT&T. There were meetings with the PSC and its staff to try and iron out some of the

differences, and ultimately a contract was presented to the Commission. And the Commission, with some minor modifications to it, agreed that was the best contract at that point in time. Our system will become operational on January 1, 1989.

In addition to some of the standards that I have already mentioned, there are some other standards that I wish to present to you because they are very important in keeping in mind that this telephone service is considered a basic operating service. Costs should be treated as normal operating expenses to the local exchange companies. Charges for calls should be from point of origination to point of termination, and should be independent of the actual routing that occurs.

Another standard that the commission determined was that an advisory board should be established. The advisory board in our state will assist in providing input advice on operator training, consumer education, problem solving, and future enhancements. That's a tall order for an advisory board. Right now, we are concentrating logically on operator training and consumer outreach and education activities. We had our first meeting just last week. It was a doozy. Keep in perspective that it was a good dialogue between AT&T, the local exchange companies, the PSC and the user community. Things were presented that would have never occurred to those of us inexperienced in the world of hearing impairments and deafness. We were provided useful information about how billings can be better structured, useful information about what we need to find in operators--their experience in ASL, their ability to type accurately, and to speak accurately. All of these things were presented and we all have some tasks in front of us which we will have to meet in order to be prepared for our next meeting which will take place next month.

The last thing I want to talk about is a standard in which the commission said that the local telephone directory and bill inserts, at least once a year, should contain information on the relay service so it won't become lost in the myriad of pages that people get in their bills. Also we feel that maybe the hearing community is the community that needs to be the best educated about this since this will be a very new and different service to them. Our feeling in New York has been that the deaf community has always encountered obstacles in their communication needs via the telephone. Most have heard about the relay service since AT&T and the Public Service Commission have travelled throughout the state to various seminars and made presentations.

January 1, 1989 is the big day. It's hard to say where call volume is going to be. At this point in time our best guesstimate has been 100,000 calls a month. The budget for the first year will be $10.9 million. If we were doing it on a cost-per-access-line, it would turn out to be approximately 9.2 cents a month. We are estimating there will be approximately 162 relay operators for the first year and, as you can see, funding will be recovered from the user phone bills and assessments to the local exchange companies, who will treat the costs as local operating expenses. In other words, they will place the costs not recovered through the charges for the calls in their rate bases. We want to make sure that the standards for operators that exist in the telephone system and the telephone network now will exist for the relay service.

As I explained, the telephone companies are responsible for the provision of a relay service but in New York, they have contracted out with AT&T. The relay service will operate 24 hours a day, seven days a week. Users will be charged 50% of the tariff rate of a call placed without the relay. There has been some discussion of that lately, since New York state already has tariff provisions in place which allow for a 50% discount to TDD users. It is the Commission staff's position at this point in time that the 50% rate applies to any and all cost calls placed through the relay service. That policy has to be passed through the Commission for final approval.

The AT&T PBX is a System 85. Very simply, the expenses AT&T will incur operating the relay service will be allocated among all the 41 local operating telephone companies in the state. Telephone users who use the relay service will pay for part of their calls. The rest--the actual expenses for the costs that aren't recovered through the telephone charges--will be placed in the local operating expenses of the telephone companies, and will most logically be recovered through intrastate services.

There are a lot of ways to skin a cat, as the expression goes, and certainly, as you have seen from this panel, different states have approached the idea of a relay service in different ways. I'm very proud of New York's system because I think it places the relay service where it belongs, that is to say as an operating service of the local exchange carriers. The Commission, as I explained before, has broad powers. One of those powers says that when the Commission

determines that any telephone service is inequitable or inadequate, it has the right to institute a proceeding, schedule hearings, and try to do something to make that service equitable and adequate. I think that's exactly what the New York Commission has done in this instance. It's not over with yet.

We are still looking forward to January 1, 1989. I anticipate we will probably see some problems with calls coming into the system and the system being overloaded. That won't be anything new to AT&T. It has experienced it in California. But it has learned from that experience, and it has a commitment in New York state. I think that with the help of the community and PSC and the interest of AT&T and the local exchange companies and some patience, we will see a really terrific system in New York.

QUESTION AND ANSWER

Question [Latham Breunig]: How is NYNEX involved in this?

Answer [Kathy Woods]: *New York Telephone Company [NYNEX] is one of the 41 local exchange companies in New York. As I said before, all the telephone companies in New York are responsible for the provision of this service. They have all contracted with AT&T to provide this service.*

Question [Bill Cutler]: I would like to direct my question to Jack [Levesque] and Kathy [Woods]. You have described two approaches to collecting the money without judgment, although Jack wishes "deaf" were no part of our surcharge label in California. I would like some judgment as to the philosophy or the ethics of burying the costs in the bill in New York. It sounds very slick politically, but is it legitimate?

Answer [Kathy Woods]: *Well, now, I don't consider it hidden, just as I don't consider the company president's salary hidden; we don't have a separate line item, for instance, for the president's salary. We don't have separate line items of a telephone company's marketing expenses. If their central office blows up and they have to replace it before its useful life, we don't suddenly have a separate line item that says we are now going to pay 25 cents a month for the next so many months because we have to replace the central office. In our opinion, it is just one of the many services that a telephone company should be providing as part of its basic service obligation. And as such, the costs are all melded together as part of the local operating expenses.*

Question [Cynthia Norwood]: I have two questions. First, what do you think about a voluntary system to fund part of it? I realize after listening today that we could not fund the entire amount, but in Virginia we have something in the electric industry where you are allowed to put money onto your bill, for example, a dollar or extra two dollars to help people who need electricity in the cold months. My second question is how do you know or how do we know that these costs are not going to really skyrocket, and if they do, how are we going to tell the average ratepayer, "Well, the $3 on your bill, well, it's for these particular types of situations"? Do you think it is going to happen, and if so, what do you think we are going to tell the rate payers?

Answer [Stuart Brackney]: *I am going to respond to the first part of your question. We looked at that volunteer approach. Number one, the phone company, as they participate in that type of approach, ended up telling us it was extremely expensive to have customers sign on to contribute an extra dollar to their monthly telephone bill. They wanted a Christmas fund approach where you committed yourself for a full year. The negative side of that is that what we have heard about quality and equity of service. The quality and equity of service starts to be depleted, as the funds are not there with respect to hold time for a caller to get in through the system because there is not an operator.*

This is Stu Brackney's opinion: If a relay service has a base dollar amount of funds to operate on, but it does not match its total fiscal obligation, and it must go to volunteer monies, then the fluctuation of the incoming volunteer dollars, if you will, will be directly related to the fluctuating of the quality of service as it relates to equitable service for the hearing community. In other words, one month you might have equitable service for the relay service user because there were some donations that came in to cover costs. I know I'm breaking it down into a small time element. I think you get my point. The quality element goes up and down as the donated dollars come in. Then you get the consumer who doesn't know a good month from a bad month. I could just respond very briefly to the second question that you had in regard to costs possibly getting out of

line. I think there are a number of things that we can do. First is to ensure that the local exchange carriers file tariffs, and that's where they are going to be projecting what the cost of the service is going to be. That will give the commission the ability to monitor those costs, and also establish a consumer advisory council. You can monitor those costs.

Question: What I have been hearing today, is it is really a cost per call? If that is true and more and more people hear about this service and you have an incredible number of calls coming in, who is to know what that limit is going to be? I'm not saying there should be a limit; don't anybody get excited. Who is going to know how that's going to go?

Answer: *One thing we are going to be talking about later on in the week is the new technology and the computer technology that may very well be able to cut the costs, the manpower, people power costs.*

Comment [Joe Heil]: I would like to respond to the last question. Number one, I think it's a question of dignity and rights. I don't think anybody wants to be a charitable case. When you start asking for volunteer funds to help those quote, poor deaf people, I think there's a complete loss of perspective and dignity. Let's go back to your question of the quality. Until the deaf person's average residential calling rate exceeds the calling rate that I make or any other hearing person makes, then I will never be surprised if the volumes keep going up until they reach the same level of using relay and making the same amount of telephone calls that I and the rest of the hearing people do.

Question [Eileen Alter]: I am responsible for trying to acquire funding for a relay service. I have been looking at going to the legislature in Texas. I have already been approached with trying to determine specific numbers to explain to our legislature and explain to other people who will be making a determination of what our costs will be as to what precisely they will be buying. I have been basing my figures on those costs generated by you folks up there, and that does not seem good enough. I was surprised to learn yesterday that New York was able to use California's figures and get that passed. Unfortunately, I have been asked to explain precisely what the million dollars that I'm proposing for administrative costs will buy, as well as the other $3 million. How do you go about getting those precise figures that are present on accountants' reports--those things that are proprietary information? How do I go about doing that without spending a year before getting anywhere?

Answer [Stuart Brackney]: *There is an annual report of the dollars spent that I am required to give to the budget committee for the state of Arizona. This gives you a summary--this is prior to our rate increase--of what our dollars bought us with the distribution of TDD and relay service. I brought additional copies for the rest of you if you would like some after today's session.*

Answer [Pamela Ransom]: *In Illinois, we believe that the telephone companies were in the best position to provide that kind of statistical information so that the Commission requested that the telephone companies provide the dollars and cents figures. The hearing impaired community established the standards of service. There was some latitude, but we were more concerned with the actual standards and the specifications. We set up the rules, and then we let them develop the numbers.*

Comment [Jack Levesque]: I'm off the point now but I've been studying the charts, the organizational factors, and I heard people talk about advisory groups and so forth. I'm concerned, where do the deaf people, the hard of hearing people, the deaf and blind people fit in terms of control of the program that it is supposed to serve that population. Are we subject to the good will of people who may truly control those programs, or do we have some clout? Really, advisory groups have no power. It is up to them to advise, but others make the decision. Where is the management in those programs? Do deaf people have 50% control of that? No. I look at the Illinois ITAC. Are there 51% deaf people on that? I don't know. I haven't seen those figures. I know there is a problem in California. We want more deaf people as managers, and we will avoid many of those little problems that we had before. In New York, I look at the organizational chart. Where are the deaf people? They are all below the top. I'm very concerned about that.

Question: I just moved to California, and we cannot use our relay services out of state. We resent that we have to pay $2.60 a month for the use of the services that we can't access. So I'm wondering if the deaf community of California has approached this issue, if

you will face the same problem there. I don't want to pay for any service that I can't access.

Answer [Kathy Woods]: *The $2.60 doesn't truly represent the ability to make interstate calls. To reuse the phrase that Mike used and Pam used, this is part of "the peculiar world of telecommunications." The $2.60 doesn't represent the ability to make interstate calls. It used to be that toll charges, which were very overpriced, helped pay for your local access line, which typically (at least it is in our state and most states) is underpriced. That means that the access line is priced below its true cost. What the FCC did was to place the costs more squarely where they belong. Instead of overpricing toll charges to pay for local exchange access, it is trying to bring those costs down where they belong. The $2.60 doesn't represent the ability to make interstate calls.*

Comment [Michael Hurst]: That's a reasonable argument, but the FCC has jurisdiction over that $2.60 because it is considered interstate in nature, and that's what gives the FCC the ability to impose that rate. Where does the FCC get off imposing this fee on people who have no service at all because they can't use interstate service? It is like splitting hairs to say what you said. I mean, the FCC is imposing a charge directly on customers. It has the authority to do that because it is an interstate service. And some of the people they are imposing that charge on cannot use the interstate service.

Answer [Kathy Woods]: *Then you could make the argument that the telephone charges–if they can't use that phone service, they shouldn't pay for that either?*

Comment [Michael Hurst]: There is an argument there, too.

Answer [Kathy Woods]: *In all honesty, I think that there is a pervasive misconception regarding the FCC access charge. It is somehow to accommodate interstate calling. It strives to place the calls more squarely where they belong instead of overpricing toll charges like they did in the past.*

Answer [Jack Levesque]: *While the legislation that approved relay service and then created the D.E.A.F. Trust Fund and established the system for relay service in California, they did not approve funding for interstate calling, and that is why today we have still not gotten under way with interstate calling in California, although we are hoping to follow the model of New York and begin to implement interstate calling within the next year. I would also like to point out that TDD users in California <u>can</u> place interstate calls on a TDD-to-TDD basis. They are not precluded from that in California. That service is available to consumers in California.*

Answer [Kathy Woods]: *I know there is the belief that New York's system will accommodate interstate calls. But I would say at this point in time that I am not convinced that will happen. The reason is not a technical one. AT&T could accommodate interstate calls. The reason is an administrative one. First of all, there is the issue of filing the appropriate tariffs with the FCC. Secondly, there is the issue of equity. As you know, what the user pays for a call truly doesn't represent the cost of the call. A user may pay three dollars when the true cost of the call was really eight dollars. That leaves another five dollars that has to be assessed to somebody. In our state, it would be assessed to the New York state ratepayers. However, assessing that charge to all the New York state ratepayers for a service that would benefit residents of other states is clearly not fair, so I'm not exactly sure how we are going to approach that issue.*

Question [Judy Tingley]: Because of the comments made by the person from Texas, I think it's important to point out that the number of operators showing on the chart is not a reflection of the work force of operators, but I believe that is actually a reflection of the number of operator stations, given the different shifts. I don't know, Jack, do you know how many operators are actually working in the relay services? We have 120 positions but they work three shifts so the total is really more than that.

Answer [Phyllis Shapiro]: *At the California Relay Service we currently have 225 communication assistants that relay calls. The 120 that Judy is referring to, and that Jack showed on his viewgraph, represents the number of work stations available for them to sit at during a 24-hour period on a given day; so we have a total of 225 communication assistants.*

Comment: I've noticed that the interpretation of the Commission's jurisdiction is different in each state, and that the New York model seems to be far better. The

FCC so far has had difficulty in interpreting its jurisdiction in the area of relay services.

Answer [Kathy Woods]: *Yes, I recognize that they have had difficulty. Actually it should come as no surprise because the FCC has typically had jurisdiction over interstate communications and has left intrastate communications to the states.* Louisiana vs. the FCC *was a case that was a very important one because it was one that delineated once again here the FCC's boundaries are, and where the states have their own boundaries. I think the issue of an interstate–a national interstate relay service–is going to be a difficult one to address, but I certainly hope it will be [addressed].*

Members of the panel on Financing Models in State Programs.
From left, Pam Ransom, Brenda Stansbury (interpreting), Jack Levesque, Stuart Brackney, and Kathy Woods.

CALIFORNIA RELAY SERVICE

Phyllis Shapiro[*]

History

The California State Senate passed Senate Bill 597 in 1978. This legislation mandated the distribution of free, loaned Telecommunications Devices for the Deaf (TDDs) to all Californians who were deaf or severely hearing impaired. As this statewide program grew, so did the demand for relay calls. This demand could not be met by the local relay services operating in California at the time. The local relay services were mostly nonprofit, obtaining funding from a variety of sources, and were not operating 24 hours a day, seven days a week. They had limited access because of their size and number of available telephone lines. Therefore, even with the TDD distribution program, access to the telephone network between speech and/or hearing impaired and hearing people was still inconvenient and sometimes impossible in California.

The first relay service bill, authored and introduced in the California legislature by Martha Reed of Freemont, California, was S.B. 960. This bill initially was tabled due to some opposition from interest groups serving the deaf community. One year later, Bill White, a Sacramento resident and first vice president of the California Association of the Deaf (CAD), helped rewrite the bill. It was then presented to Senator Bill Greene (Los Angeles) who introduced it and actively supported its approval. The Telecommunications Devices for the Deaf (TDD) Relay System Act, now known as S.B. 244, was signed into law in 1983 by Governor George Deukmejian. The funding for provision of the new dual party relay service was to be the same as that for the TDD issuance program. Thus, both programs would share dollars collected from the three-cent (with capacity to expand to ten-cent) surcharge applicable to all access lines within the state of California. This money was called the Disabled Equipment Acquisition Fund Trust (D.E.A.F. Trust), and management of the fund was entrusted to an administrative body called the D.E.A.F. Trust Administrative Committee.

The California Public Utility Commission (CPUC) was required by the new law (PU Code, Section 2881 [b]) to design and implement a program whereby each telephone corporation within the state would provide a dual party relay system. The CPUC issued an Order Instituting Investigation (OII) Number 84-12-026 which requested written comments from the telephone companies and other interested parties. After the filing of these comments, the CPUC made decisions regarding the scope of the California Relay Service (CRS). All major respondent telephone companies (Pacific Bell, General Telephone of California, and AT&T) were required to design a single relay system in accordance with these previous decisions. During this design phase, the major respondents were obliged to solicit the advice, counsel, and physical assistance of statewide, nonprofit consumer organizations for deaf persons.

The CPUC adopted the relay system design set forth by the System Design Committee, with some modifications proposed by other respondents. AT&T, in February of 1986, was directed by Order of the California Public Utility Commission to implement the system design and to be the administrator of the California Relay Service.

System Design

The system design ordered by the CPUC for the California Relay Service included monthly call volume

[*]Phyllis Shapiro, Manager, California Relay Service, 20931-A Burbank Boulevard, Woodland Hills, CA 91367

estimates, call duration estimates, staffing requirements, network configuration, customer access capability, relay to called party capability, relay position equipment, real estate assessment, billing, revenue, and costs. Also mandated was the area in which the relay center should be located, and the size of the managerial and work forces. Specifically, additional CPUC findings of fact included in the Order were:

- The relay would be operational 24 hours a day, seven days a week, and holidays.
- Both voice and TDD customers would use an 800 toll-free number to call the relay service.
- Relay access to the called party would be through the use of a combination of IntraLATA and InterLATA WATS lines.
- Calls placed through the relay would be billed at the same rate which would apply if the call had been placed without the use of the relay service.
- InterLATA call rates would be based upon AT&T rates for InterLATA calls.
- Revenues received for calls placed through the relay would be passed to the D.E.A.F. Trust Fund and used to help offset the relay's operating expenses.

Implementation

A site for the center was selected in Woodland Hills, California, in June of 1986. Construction began that month to renovate the space according to plan specifications determined by AT&T and the architects. This space included separate areas for the lounge, the foyer, and a public office equipped with booths and TDDs available to hearing impaired customers.

Trunk arrangements were made, 800 service and WATS service ordered, and call handling equipment installed. This equipment included an AT&T System 85 Call Distribution System, which distributes incoming calls to the longest available communications assistant (operator) evenly throughout the day. Also, with the System 85, the associated call management system was installed. This has capabilities to collect and report all manner of trunk states, such as "idle," "queued," "connected," and "abandoned." The Call Management System provides capability for administrative reports, which include average call holding time, percentage of busy signals, number of calls handled, positions occupied, and positions busy. These reports, available on the half-hour, hour, period of day, day of week, and/or month, provide invaluable data for the management of an office the size of the California Relay Service. The report data assist managers in long-range, weekly, and daily planning processes. The planning processes involve estimation of call volumes for each quarter hour of each day and then evolve to provide a schedule of work hours required to meet customers' calling needs throughout each day.

Work stations with video display terminals, acoustical panels, and modems were installed. Extensive quality analyses involved trialing, testing, and re-testing of trunks and all equipment until the implementation team was assured of absolute operability and capability. During this time, newly assigned CRS managers began to learn about the somewhat unique task that lay ahead of them. They toured several relay services in the United States and Canada, and began to meet and interview their future customers to gain a perception of their special needs and expectations. They requested bids for specialized sensitivity training of the communications assistants, and compiled a training package to include:

- sensitivity to the cultural and linguistic differences between the deaf community and the hearing community;
- development of an understanding of how American Sign Language (ASL) and English vary in form;
- development of an appreciation for the difference between interpreting and transliterating, and how and when to interpret various forms of written ASL to verbal English and verbal English to ASL;
- development of abilities to cope with certain ethical or difficult situations that might occur;
- knowledge of the ultimate importance of adhering to the AT&T professional code of ethics and strict code of confidentiality; and
- knowledge of the fundamentals of call handling, i.e., call types, equipment expertise, billing, customer expectations/satisfaction.

In July of this implementation period, AT&T began advertising extensively for the communications assistant jobs. Letters were sent to all existing relay services in California. The job description, salary, benefits, and available employment dates were included in the recruitment package. Results of this effort were beneficial, and many of the employees came on board with experience in call relay service.

Also, during this time, with the help of all the telephone companies in California, the task of notifying customers of the new service and its future availability began. Special bill inserts were written and mailed to all California residents with telephone service. Newspaper articles were published. Brochures describing the service and instructing customers on how to reach and use CRS were designed, printed, and issued to community agencies, social service agencies, schools, and any and all outreach agencies with potential for notifying the public.

The first group of CRS communications assistants reported for training on November 10, 1986. By January 1, 1987, all 123 communications assistants and all CRS managers were trained and ready to begin.

At midnight January 1, 1987, as ordered by the California Public Utility Commission, CRS began providing call relay capability 24 hours a day, seven days a week to all California telephone customers. CRS had 60 positions, one manager, eight group managers, and 123 communications assistants.

Operation and Call Volume History

The CRS system design was based on estimates that the service would handle approximately 50,000 calls per month. However, in the first month of operation, CRS handled 87,511 calls. Demand grew continuously until forecasts revealed CRS would not have position capacity to handle 1988 busy season volumes. AT&T notified the California Public Utility Commission, and, with approval, began expansion. Adjacent space in the same building was available for the expansion, so both units were able to share the AT&T System 85 Call Distributor, Call Management System, public office, in-charge space, and lounge and locker areas. By January of 1988, CRS had 120 positions, two managers, 16 group managers, two clerks, and more than 170 communications assistants. It handled 200,718 calls.

California Relay Service Call Volume History

	1987	% Change Over Preceding Month	1988	% Incr. Over Same Month Preceding Year
January	87,511		200,718	229%
February	94,932	+ 8%	181,715	191%
March	124,457	+31%	199,657	160%
April	137,656	+11%	198,671	144%
May	147,084	+ 7%	208,690	142%
June	160,402	+ 9%	223,838	140%
July	171,870	+ 7%	246,581	143%
August	174,842	+ 2%		
September	173,037	- 1%		
October	172,264	- 1%		
November	170,043	- 1%		
December	179,292	+ 5%		

By year end 1987, calls had increased overall by 205%. From January to July, 1988, calls increased by 123%.

A chronological history of CRS call volumes and percent increase month over month, year over year, is shown below.

Calling Patterns

Monday through Friday (business days), call traffic is usually busiest between 10 a.m. and noon. Total business day volumes are currently in excess of 9,000 calls, with an average six and one-half- to seven-minute talk time. On weekends, call volumes generally peak from 6 to 8 p.m. These hours do vary, however, and can be dependent upon activity in the community from week to week. We have found many CRS holiday traffic patterns are not comparable nor consistent with those patterns of our traditional operator services.

Approximately 80% of the calls at CRS are originated by TDD customers, with the remaining 20% initiated by voice customers. This split has remained more or less constant since the opening of CRS.

CRS and AT&T

The most notable challenge for AT&T throughout the brief 19-month history of the California Relay Service has been meeting the ongoing increase in call demand while continuing to satisfy our customers with the highest quality call handling. Along with this has been, and will continue to be, a commitment to the community we serve. This is a commitment to provide our customers with the quality of service they expect; a commitment to truly know our customers, listen to our customers, and be visible in their communities; a commitment to provide the best technological and human relay interfaces possible for the benefit of communication and, indeed, the enhancement of our lives.

AT&T has been honored in its role of implementing and administering the California Relay Service, and is proud of its partnership with the people of California in the provision of the first statewide relay system in the United States.

Relay Service for Text Telephone Customers in Sweden

Börje Nilsson[*]

The introduction in Sweden of a relay service (RS) for text telephone customers was decided by Parliament on May 22, 1981. Before that, there had been investigations and test activities.

The Telecommunications Administration (Televerket) was ordered to organize the RS. The costs would be subsidized by the state. Televerket located RS in four places in the country. A central operational office was to be connected to one of them, in Kalmar. The division into four offices was decided after negotiations with the trade unions in accordance with Swedish law about co-determination. Reasons given included the need for jobs in certain places and the need for a better job mix for operators. (Most telephone operators are dealing with only directory service, a highly repetitive job.) The RS started during the first half of 1982.

Text Telephone Relay Service: Standards in Sweden

Main Rules

"Text telephone subscribers should be offered the possibility to communicate with ordinary telephones. To the extent that this facility is not provided automatically, it should be provided by an operator in a manual center. The operator's involvement should be strictly limited to transmitting and receiving exact messages without any obligation to resolve linguistic difficulties." (From a recommendation given by the European Conference of Posts and Telecommunications Administrations [CEPT] in 1980.)

"When there is a desire for a new service we must try to fulfill that demand as far as possible and to the extent that technology allows, if necessary with the use of provisional solutions." (Statement concerning the relay service by the Director General, Tony Hagström, in a letter to Hörselfrämjandets Riksförbund--The Swedish Association of the Hard of Hearing--dated February 24, 1987.)

"Text telephone customers shall, as far as possible, have access to the same service as other telephone customers." (Objective for the Swedish relay service.)

Service Offered Today

At present, we offer:

- Domestic calls.
- International calls in Swedish. (Calls in other languages are also handled if there is an operator on duty who can do the job. In most cases we can offer service in English and German.)
- Collect calls. (A text telephone subscriber does not have to pay an extra fee for this service, nor does a hearing customer calling the relay service from a telephone booth.)
- Personal calls.
- Time-scheduled calls.
- Automatically dialed calls to the RS from abroad (charged in the foreign country, not in Sweden).

[*]Börje Nilsson, Manager, Telekontoret, Swedish Telecommunications Administration, P.O. Box 935, 391 29 Kalmar, Sweden

- Calls from and to telephone booths, public call offices, and hired customer rooms.
- Phonotelex calls (calling the telegraph office to send a telex message).
- Telegrams.
- Conference calls. (This is now offered on a trial basis, accommodating no more than three people and only one text telephone customer.)
- Mobile calls.
- Calls to and from ships at sea.
- Emergency calls. (But all alarm centers have text telephones.)
- Radio paging. (This helps to alert a subscriber with such equipment.)
- Directory information.
- Interception of calls.
- Expediting of calls in progress.
- Telephone queues.
- Absent subscriber's service.
- Wake-up service. (The customer must have a special outfit, such as a vibrator, etc.)
- "Message." (The operator takes a message to be forwarded later. It is charged as a call of the corresponding time if ordered from a text telephone. This is of special value when the customer has no access to a text telephone during working hours.)
- "Commission." (This can be ordered only from a text telephone. It is like "message," but the operator will call the ordering subscriber afterward and provide a report--for example, about an appointment.)

Organization

Strictly from a practical point of view, it would have been better if there had been only one RS office for the whole country. If a group of cooperating callers is divided into two or more groups, it will normally result in lower productivity or a lower grade of service to the customers unless the first group is very large.

To avoid this, all operator positions are permanently connected to a call selector, which is common to the whole country (see Figure 1). An incoming call is directed via the call selector to the operator who has been free for the longest time (if there is a free operator), regardless of where the operator is located. If no operator is free, the call is directed to a queue.

The total number of RS calls handled today would require about 100 full-time operators. However, as the operators are dealing with RS for only a part of their daily working hours, as many as 300 to 400 persons are involved. This is favorable for the operators, but it means higher costs for training and certain problems if we want to introduce so-called chord keyboards, allowing typing at the speed of speech.

Rates and Fees

The costs for the human assistance in the RS, about $6 per call, are totally subsidized by the state. Thus, the customer never has to pay more than for an automatically switched call of the same duration. Special services must generally be paid for by the customer (except for collect calls under certain conditions).

Trends

The original planners of RS had projected the number of calls per text telephone to be about seven per month in the steady state, which was supposed to be reached within two years of its start. At that time, the number of text telephones would have reached its estimated top level, 5,600, and the number of RS calls would then be 40,000 per month.

However, developments were slower. Not until now, years later, have we reached those estimated levels of usage. On the other hand, the number of calls per subscriber and month do not seem to level off (see Figures 2 and 3). The increment per year was about 15% for a couple of years. The exact number of text telephones in use cannot be given, as the subscribers now own them themselves and there are many suppliers. But we estimate the number to be near the calculated end level, 5,600. As childhood

Figure 1

RELAY SERVICE FOR TEXT TELEPHONES IN SWEDEN

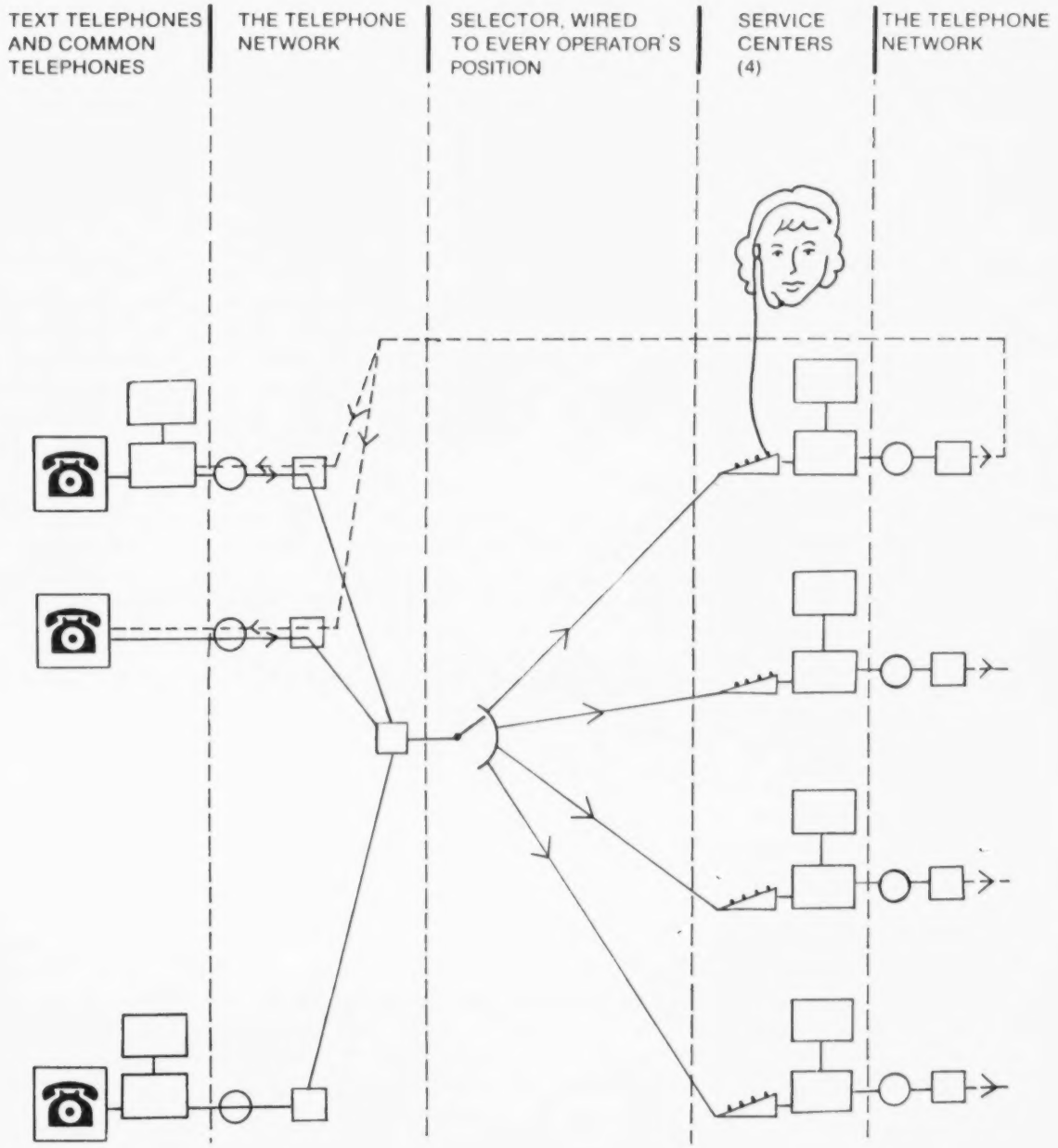

TEXT TELEPHONES AND COMMON TELEPHONES
THE TELEPHONE NETWORK
SELECTOR, WIRED TO EVERY OPERATOR'S POSITION
SERVICE CENTERS (4)
THE TELEPHONE NETWORK

Figure 2

Text Telephone Use
January, April, July, October

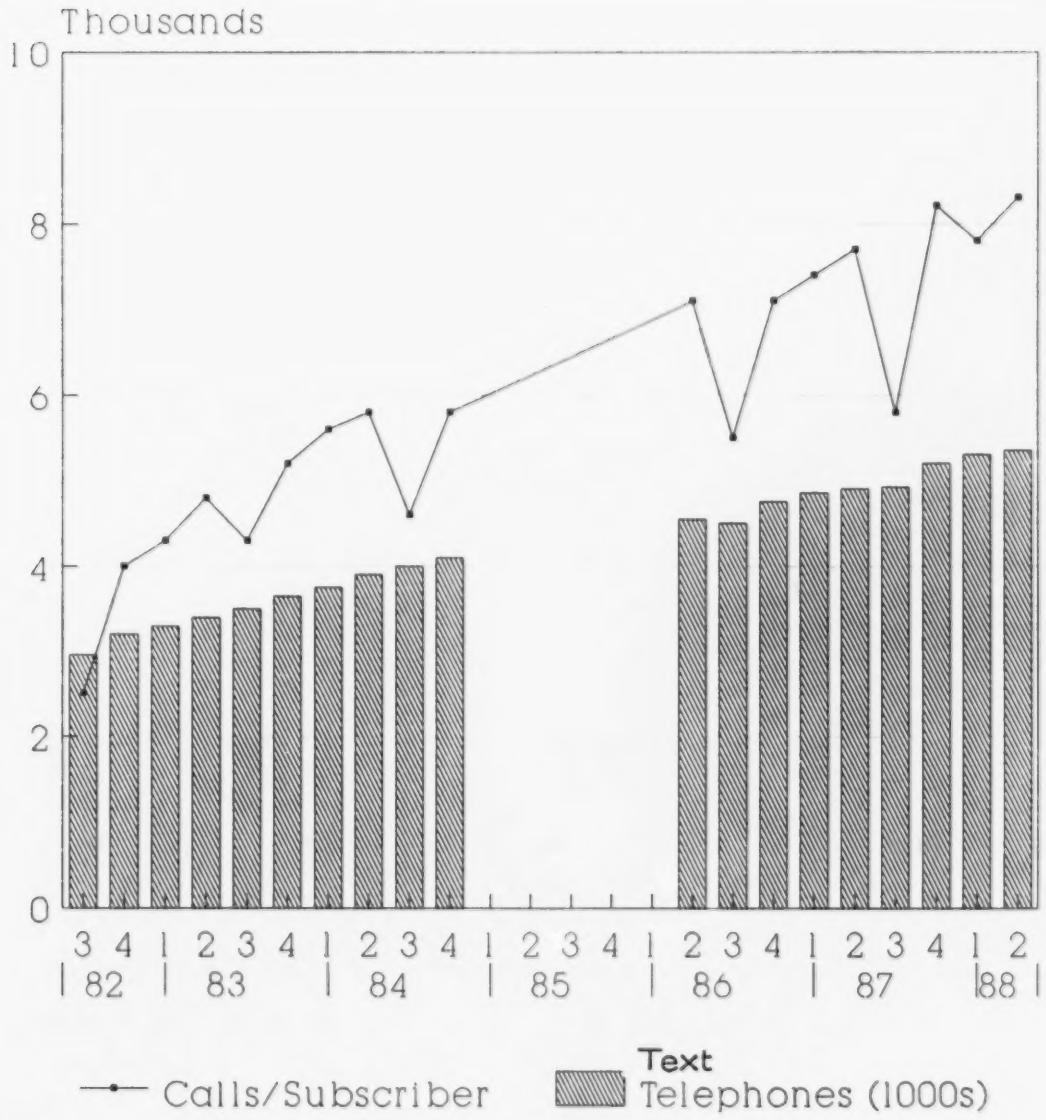
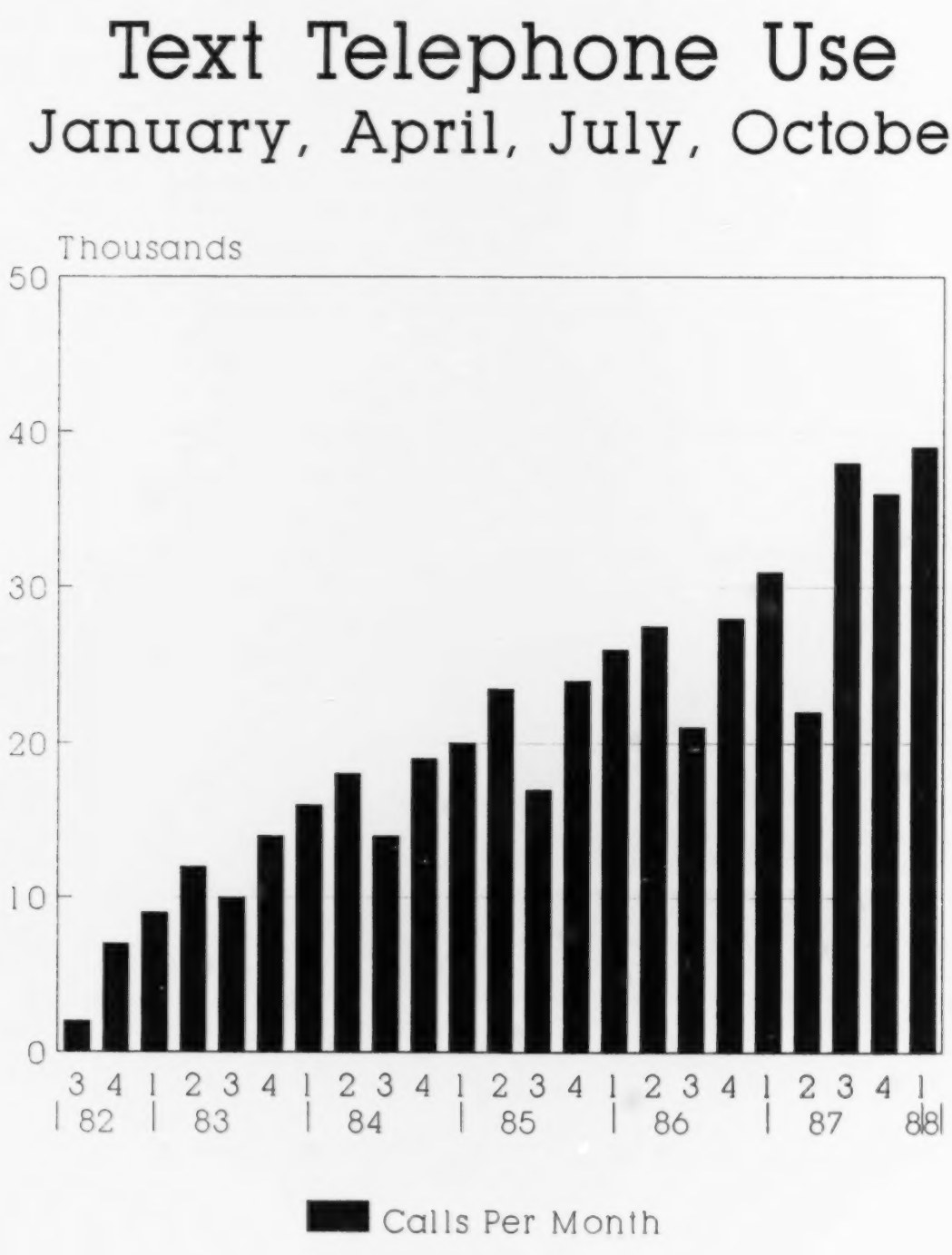


Figure 3


Text Telephone Use
January, April, July, October
Thousands
50
40
30
20
10
0
3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1 2 3 4 1
82 83 84 85 86 87 88
Calls Per Month

deafened persons often live together, about 8,500 disabled persons may have access to a text telephone within the country today.

There are some reasons why the development was slow. Poul Poulsen at the Stockholm Deaf Interpretation Centre provided the following information about the distribution of text telephones within the Stockholm area:

- childhood deafened persons 65%
- adult deafened persons 30%
- speech impaired persons 5%
- deaf-blind persons 0.5%

Two years ago, 50% of the childhood deafened people did not dare call the relay service, despairing about their ability to make themselves understood. (But they used the text telephones for direct calls to other deaf persons and to the deaf interpretation service.)

Adult deafened persons often have not been very motivated to use the text telephone. One reason may have been that the RS system did not, until now, give them the opportunity to talk directly to hearing persons. Another reason is that most of them are elderly.

Thus, there has been a great need for information, training, and encouraging. It also has taken time to trace and persuade older adult deafened persons to use the service. Now the adult deafened text telephone users comprise the most rapidly growing category of RS users.

Calls from hearing people to text telephone subscribers through the RS have increased from about 20% to about 25% of the total number of relay calls. We have tried to encourage calls from hearing subscribers in many ways, such as one-minute television commercials and information inserts in telephone bills and telephone directories. The RS subscribers also have received free printed cards, to be sent to their acquaintances.

Traffic Flow and Handling Call Volumes

The traffic flow varies over seasons, weekdays, and hours in the day (see Figures 4 through 6). Once a year we calculate the number of manned stations needed for the whole country. We calculate for each half hour and for weekdays and weekends. We follow up by counting the calls per hour during two weeks every quarter of the year and make adjustments if necessary. (The statistics are not yet automatically put together in our provisional system.)

The total number of manned stations is divided so that every service center (SC) gets its share. We can do so because our four SCs work together as if all the operators were sitting in the same room. Each SC makes its own duty roster. RS duty is "put in layers" with other operators' service duty so that the operators get variation in their daily work.

At the central operational office we also follow up the service from the subscribers' point of view by making calls to the RS every morning and afternoon. If we find a trend indicating lack of operators, we increase their numbers.

The number of operators available at the SC varies from day to day, depending on sickness and other factors. We use a computerized conference with a special program to keep each other informed about the current staff situation. If the total number indicates a shortage, the offices with a shortage must make arrangements to eliminate it.

For our calculations, we use tables based on the Erlang loss formula for waiting systems. A problem is the waiting time for calls that are not answered immediately but are put in a queue. The average waiting time for such calls will increase with the average operating time and the operators' grade of occupation in accordance with the following formula (evaluated by Erlang):

$$t = \frac{s}{n\,(1 - \varepsilon)}, \text{ where}$$

t = the average waiting time for calls that are put in a queue

s = the average operating time for a call, in seconds

n = the number of manned operators' places

ε = (the alpha value), the average part of the time (less than 1.0) in the stations during which the operators are occupied with work.

As every RS call in Sweden occupies the operator about 500 seconds, the waiting time in the queue will easily get so long that the call will be terminated

Figure 4

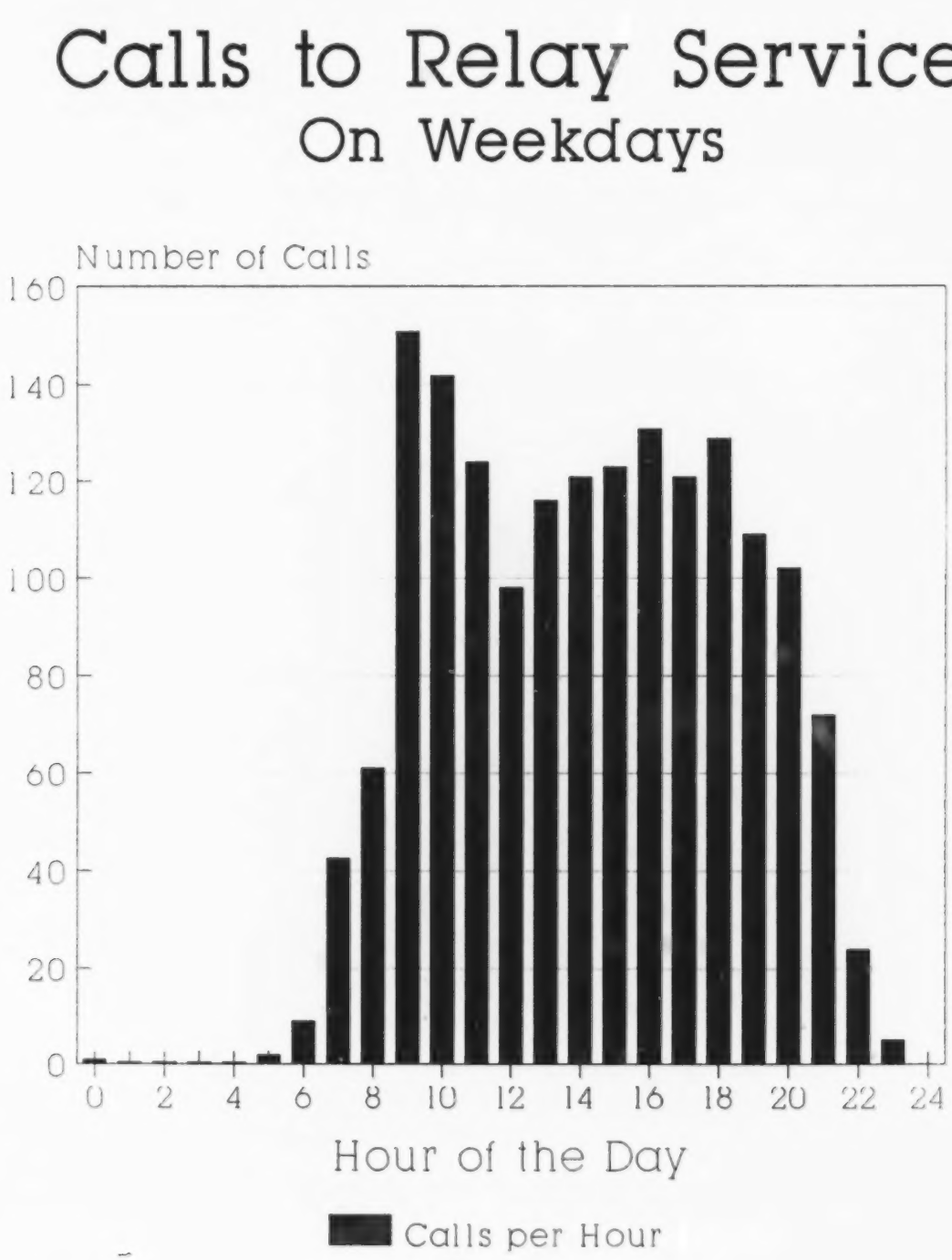

Calls to Relay Service
On Weekdays
Number of Calls
160
140
120
100
80
60
40
20
0
0 2 4 6 8 10 12 14 16 18 20 22 24
Hour of the Day
Calls per Hour

Figure 5

Calls to Relay Service
On Saturdays

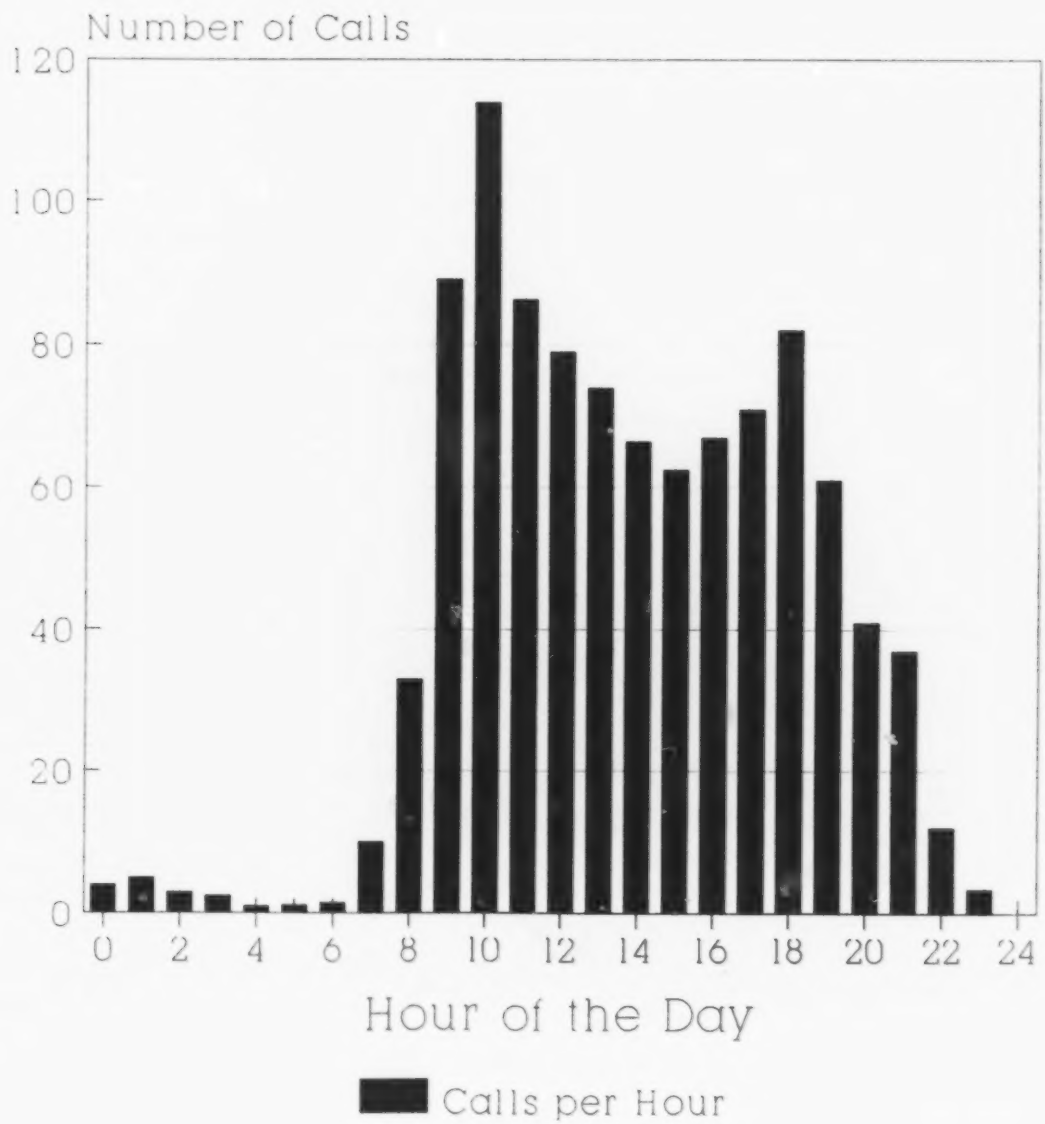
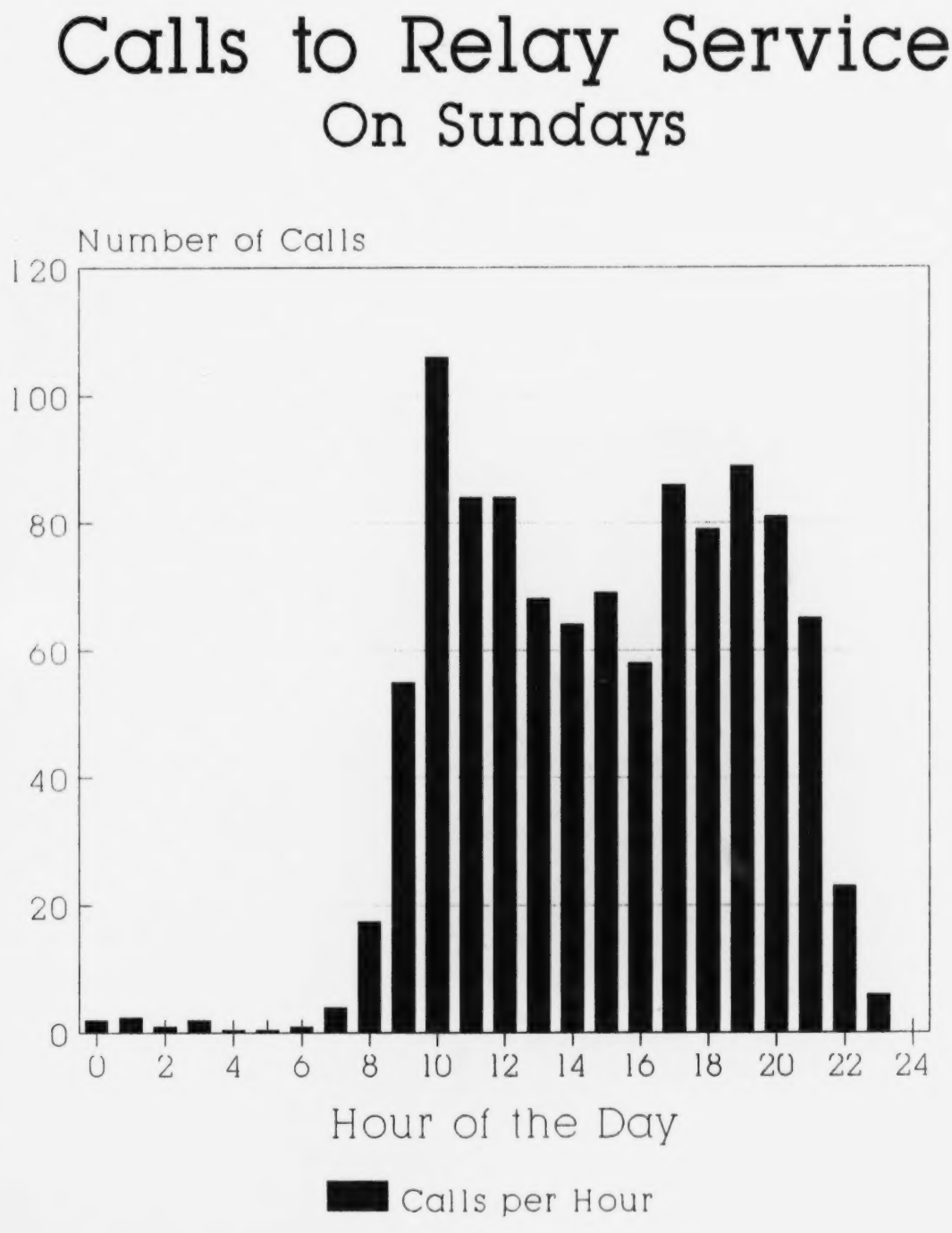


Figure 6


Calls to Relay Service
On Sundays
Number of Calls
120
100
80
60
40
20
0
0
2
4
6
8
10
12
14
16
18
20
22
24
Hour of the Day
Calls per Hour

before getting answered (about 120 seconds in Sweden).

If the waiting times should be kept so even that a call would seldom be terminated, we would need a cooperating group of operators (n), amounting to 100 or more, in accordance with the formula above. However, the amount of traffic in itself never requires more than 25 at the same time.

One way to level the waiting times would be to keep the alpha value low, i.e., to increase the number of stations manned and thus give the operators less to do, but that would mean higher costs and other problems. We are discussing the possibility of integrating the RS with other operators' service. That would give us the big cooperating group and even out the waiting times.

Training RS Operators

Our RS operators are telephone operators who must have about half a year of experience before we train them for relay service. As a rule, all operators are supposed to be eligible to work in the RS, but there are some exceptions. We observe during the training if a person has the ability to relay correctly. This is the most important thing. Of course, he or she must be a fairly skilled typist, which is a condition for being employed as an operator today. The need for rapid typing is often discussed. Our operators should be able to type about 700 characters per three minutes [about 40 words per minute]. Some disabled persons cannot read that quickly while others think it goes too slowly.

Some operators cannot endure dealing with the RS because of the most personal matters that are sometimes handled. We do not force them. There are many others who like the job in the RS.

Today, the special RS training normally takes three days. During the training we stress the matter of telephone secrecy, which is written in the law.

An important thing, from the deaf customer's point of view, is that during the conversation the operator must not "erase" what he or she has previously written, so that the customer can review it. It is absolutely necessary to avoid this if the customer is deaf-blind. Therefore, we do not require the typed text to be perfect as long as its content can be understood.

Deaf customers may use certain abbreviations and symbols to decrease the time of writing. The operators must know them but should not use them unless the customer has done so.

About the Future

As mentioned above, we are discussing the possibilities of integrating the RS with other operator services. We are also discussing whether or not we should introduce so called chord keyboards in the operators' places, which would make it possible to write with the speed of speech. However, that may imply still more training problems for the operators and also reading problems for the customers, as all our text telephones have discontinuous scrolling, meaning that the upward movement of the written lines appears to be instantaneous. Besides, as the operator's typing time is only 20% of the total time for a call, faster typing would save no more than 5 to 10% of the time. Within a year we order new operational equipment for the RS, and when doing this we must consider the aspects mentioned above and many others, such as:

- simpler charging;
- the possibility to break into a call;
- automatic answer and stored written phrases;
- operators' text telephones automatically connected when the call comes from a text telephone;
- queue information to be sent automatically, when convenient, to customers;
- information to the operators about the length of the queue;
- statistics automatically put together; and
- "storing box," for messages to be phoned by the operator at an appointed time, with "alarm clock."

Of course, the new equipment must allow a talking deaf customer to talk directly to the hearing partner (and a speech impaired person who can hear to listen to what the talking partner says).

Appendix

Text Telephones In Sweden: Milestones

- Inter-Nordic discussions started in 1974 (the "Telemedel" group).
- A first field test with "TV phones," made in the USA, was carried out in Sweden in 1975-76.
- The first Swedish model, "Diatext I" developed by the Swedish Telecommunications Administration (Televerket) in accordance with the Nordic specification of requirements, was delivered from 1979 onwards. It is sold in Finland, Norway, and Sweden. (HS technical specifications are: V 21, 300 bits/s. Alphabet CCITT nr 5, ISO nr ESC 2/8 4/8). Germany, Switzerland, Austria, Belgium, and Spain use the same code but 110 bits. Denmark and Holland use a special system, based on DTMF (Dual Tone Multi-Frequency).
- "Diatext II," the latest and probably last model initiated by Televerket and sold by TELI AB, has been delivered since 1985 to the Nordic countries except Denmark.
- Today there is also a privately developed model, "Polycom," subsidized by the Swedish state.
- Deaf-blind persons use "Versa-Braille" (there are 24 within the country).
- Personal computers now often will be used as text telephones. As PCs get cheaper and cheaper, Televerket will not initiate the development and production of new text telephones, being too expensive, but will promote the adaptation of personal computers for that purpose.

A person who needs a text telephone will get one free, subsidized by the state, but he must pay as usual for the ordinary telephone. If he needs a text telephone for his job he may get one there, too. Deaf people are not specially subsidized for long call times, but most disabled people get a special allowance from the state to compensate for disability-related costs. Authorities, companies, etc. must pay the full price for a text telephone, which is about $2,000.

Robert Tolensky, Bell Canada

OPENING A WORLD OF COMMUNICATIONS FOR DEAF PEOPLE: RELAY SERVICE IN CANADA

*Robert Tolensky**

Relay Service

Relay services provide a means by which deaf and hard of hearing subscribers using a Telecommunications Device for the Deaf (TDD) can communicate with hearing subscribers via the telephone.

To place a call, a deaf person calls a 1-800 number and "speaks" to a specially trained relay operator via his or her TDD. The operator reads the message on a computer terminal screen, calls the hearing party to whom the deaf person wants to speak, and relays the message.

The reply which the operator receives from the voice customer is typed into the operator's computer terminal and is transmitted to the display on the deaf person's TDD (some TDDs have a print capability). The conversation goes back and forth, with the operator acting as the in-between ears and voice.

Conversely, hearing persons also can call deaf persons by reversing the procedure--they access the relay center via a separate 1-800 number.

Although in Canada the basic service was available for a number of years on a small scale in various communities (usually staffed by volunteers and operational during limited hours), it is only within the last two years that telephone companies (telcos) in Canada have begun to provide relay service on an in-house basis. (See Figure 1.)

Deaf consumers and agencies participated in the planning of the service and have helped to formulate policies and standards. Their input was critically important to the achievement of a better product. Feedback from users is ongoing, and there is no shortage of suggestions on how to improve the service.

Policy

Our objective is to treat deaf customers as much as possible like hearing customers. The telephone, which has long been a barrier to communication for deaf people, has now become fully accessible. No longer will deaf people be dependent on others to make calls for them. Most importantly, the service should open up jobs that have been closed to deaf people because they could not use the telephone.

Service Offering

Access

Twenty-four hours a day and seven days a week, TDD and voice customers can access the relay center in the province in which they are located. During peak calling periods (usually in the morning and early evening), the customer may have to make more than one attempt to reach an operator. The use of 1-800 numbers provides relay service users with only one number to remember, no matter where they are travelling throughout the province.

Training

The centers are manned by specially trained telephone company operators. Many of them were

*Robert Tolensky, Section Manager, Methods, Bell Canada, 15th Floor, 313 University Avenue, Toronto, Ontario, Canada M5G 1W9

Figure 1

CANADIAN TELCO RELAY SERVICE COVERAGE
BRITISH COLUMBIA
VANCOUVER
ALBERTA
CALGARY
SASKATCHEWAN
SASKATOON
MANITOBA
WINNIPEG
ONTARIO
QUEBEC
MONTREAL
TORONTO
NEWFOUNDLAND
PRINCE EDWARD ISLAND
NEW BRUNSWICK
NOVA SCOTIA
RELAY SERVICE EXISTS
CENTRES

113

long distance or directory assistance operators before moving to the service and have had considerable experience providing prompt, polite, and accurate service to our customers.

To supplement their skills, the operators received sensitivity training from agencies representing hearing impaired persons. They learned about deaf culture and were trained in American Sign Language structure and grammar. Of course, they also received technical training on their new equipment.

Since the introduction of the service, operators have become more fluent at communicating with deaf customers and have developed a special concern for the community which they serve.

Where Can I Call?

A TDD customer can call a voice party anywhere in the world while a voice customer is limited to calling TDDs located only in North America. The restriction on TDD connections was implemented because of a concern about compatibility problems with our relay service equipment and TDDs in other countries.

How Much Does it Cost?

The cost of installing and maintaining the operation has been absorbed by the telephone companies. There is no charge for local calls; long distance calls are billed. Because TDD communications take longer than voice calls, there has been considerable activity to make the cost of a call fairer by implementing special discounts.

Today, hearing impaired customers who provide medical certification to the telephone company are entitled to a 50% discount on their calls. Plans to expand the discounts to all relay users are being put in place and already exist in some provinces.

Privacy

All telephone company operators are well-versed on the secrecy of communications. It is against the law for an operator to give out information about telephone conversations. No records of the call are kept.

Customers feel more comfortable and free in their conversations, as they don't get to know the relay operator as they did when they used local centers that were manned by a few volunteers.

Using the Relay Center

There are no restrictions on the length and frequency of calls. To offer equal access to all users, centers limit the number of calls that can be made each time the relay service is accessed (it varies by province to a maximum of three). No statistics are maintained on individual usage.

Level of Service

During the brief history of relay service provided by the telephone companies, it has been an ongoing, unique learning experience for telephone company operators, administrators, and, no doubt, their customers.

Call volumes have yet to stabilize, and the average call length can fluctuate from a few minutes (averaging five to eight minutes) to an hour or more. (Additional information and statistics are available in Figures 2 and 3.)

It is an ongoing challenge to provide a reasonable level of service to our customers as new users come on board and additional discounts are introduced which will generate increased calling.

Summary

Customers are generally satisfied with the new service. They express their approval on a daily basis to operators and managers. There is also an ongoing dialogue between agencies representing hearing impaired persons and telephone companies (Canada and the U.S.) on ways to improve the service. Cooperation, which plays a key role in ensuring the success of the operation, will guarantee that we continue to meet the needs of the deaf community with the best technology available.

QUESTION AND ANSWER

Question: In Quebec, are the operators bilingual?

Answer: ***We have a unique situation in Bell Canada territory. We serve Quebec and Ontario, and our federal government has made French and English the official languages in Canada. In fact, the majority of users in Quebec are English. They have a bilingual operation there. We also have a bilingual operation in Ontario, even though the majority of the population is English. All operators must be bilingual to work in our operation.***

Figure 2

Relay Service Information

Province	Telco	Date Established	Population	Calls/Month[1]
British Columbia	British Columbia Telephone	April '87	2,900,000	3,000
Alberta	Alberta Government Telephone	Feb. '88	2,400,000	5,000
Saskatchewan	Saskatchewan Telephone	July '87	1,000,000	7,000
Manitoba	Manitoba Telephone	June '88	1,100,000	6,000
Ontario	Bell Canada	May '88	9,100,000	37,000
Quebec	Bell Canada	June '87	6,500,000	24,500

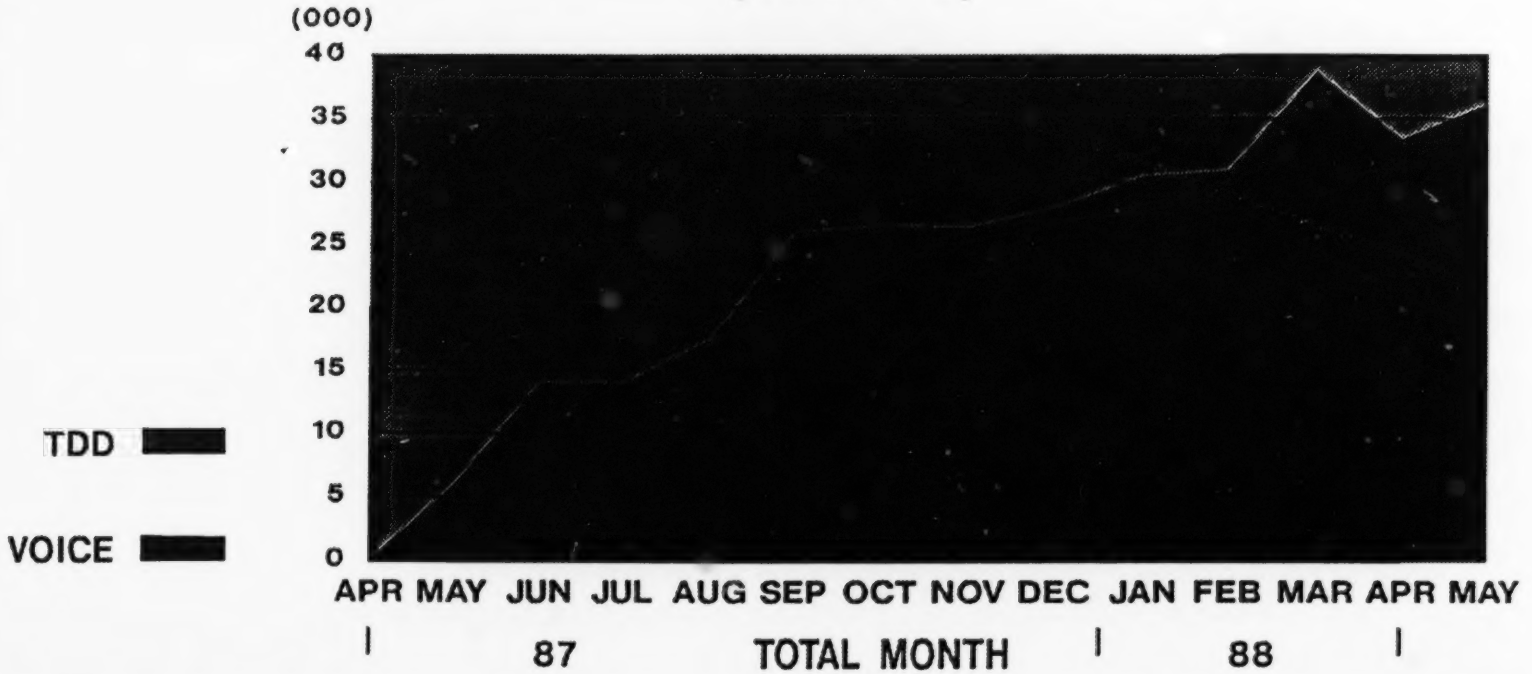
Notes

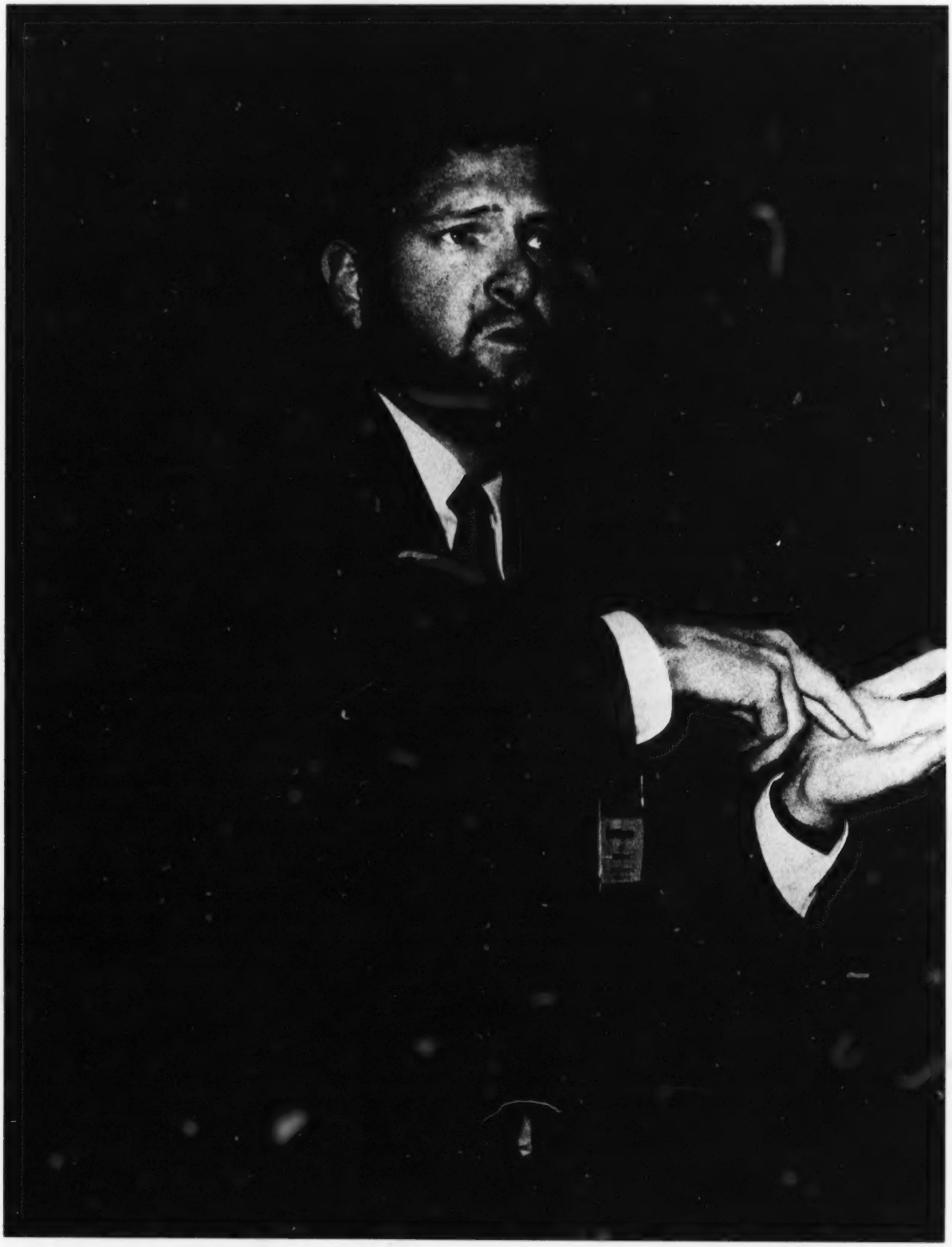
- TDD-originated calls account for approximately 70 to 75% of the calls.
- Average time of a TDD-originated call is approximately eight minutes.
- Average time of a voice-originated call is approximately five minutes.

1. For May, 1988.

RELAY SERVICE OFFERING

TYPICAL RELAY SERVICE CALL GROWTH (ONTARIO)





Paul Singleton, National Association of the Deaf

NATIONWIDE TDD RELAY STANDARDS: PARTNERS IN PROGRESS

*Paul J. Singleton**

I first used a local volunteer agency that provided TDD relay services to the San Francisco Bay Area in 1981. I was given the number by a deaf friend who told me about relay services. The number was written on a small piece of paper, and I lost the paper after that introductory call.

I made my first relay call to my insurance agent because my insurance policy was going to expire in one week. Because that volunteer relay center limited my calls to three within a fifteen-minute period, I discussed only an appointment time with my agent. I thought I'd be wasting my time waiting for further relay services and that I'd be better off driving to my agent's office to purchase an extension for my policy.

Six years later, my younger brother told me about his TDD relay experience in the San Francisco Bay Area. The California Relay Service (CRS) had started its 24 hour-a-day comprehensive TDD relay service in January, 1987. My brother said he looked up the CRS number in the *Yellow Pages*. He then called several life insurance agents in a row, and discussed the various terms of his renewed policy. With this fantastic relay service, he saved $300 a year on his policy!

Much was accomplished in developing TDD relay services for hearing impaired people in the Bay Area from 1981 to 1987. Nonprofit volunteer relay organizations paved the way for the telephone industry to assume responsibility for its deaf consumers. Now, legally, the telephone industry must maintain relay services as a basic right to telephone customers in the Bay Area; that basic right also applies to all California residents.

NAD Task Force

The National Association of the Deaf TDD Relay Task Force was established in 1987 with several objectives. First, our deaf consumers advocate for a full-fledged, comprehensive, and accessible nationwide TDD relay system. Second, we believe uniformity of TDD relay services is important when implementing the nationwide relay system, whether the system involves interstate or intrastate calling. Third, we want relay services to maintain high performance standards. Fourth, deaf consumers should know of any and all available relay services. And last, but not least, we want to work with the telephone industry and/or TDD relay operators to accomplish the aforementioned objectives through a working relationship or partnership.

Standards Development: A Participatory Process

The development of standards for TDD relay service must involve all of the constituencies in the relay process. Together, these constituencies can arrive at a mutually agreed-upon set of performance standards. A TDD relay call involves many constituencies:

- a deaf person with a TDD;
- a hearing person without a TDD;
- the TDD relay operator;
- the front-line manager in the relay center;

*Paul J. Singleton, Vice President and TDD Relay Task Force Chair, National Association of the Deaf, 814 Thayer Avenue, Silver Spring, MD 20910

- middle and high level managers in the relay center;
- deaf consumer organizations;
- the federal or state government which might fund the relay service;
- the general public or telephone customers who might possibly fund the relay service; and
- TDD manufacturers.

These constituencies can be and should be viewed as partners in progress. Each plays a role during the relay process. A participatory decision-making process is the most effective approach, allowing each participant to contribute to an effective relay service.

Planning and Maintaining the Standards of Relay Service

Competency standards for operators (e.g., ability to type 60 words per minute and interpret American Sign Language into text form), system standards (e.g., hours of operation and penetration rate), and ethical standards (e.g., confidentiality) are key components of a good relay system. Each component requires careful planning.

Planning begins before a relay system is proposed and developed. Input from experienced operators, technicians, TDD relay customers, hearing people without TDDs, and other participants in the relay process should be included in designing the proposed relay system.

Once the relay system is established, one of its major tasks is to maintain the standards established in its blueprint. Continuous input from a cross-constituency team assists the relay operators in countless ways as they strive to maintain high standards.

Organizing Input from Participants of the Relay Process

Some examples of organized input from participants in a relay process are outlined on the following page. Some problems also are outlined.

In Texas, the RFP review team to award funding for relay projects includes a broad representation of participants. Also, nonprofit organizations applying for Texas funds must include deaf members on their boards or advisory boards. This ensures their input.

In California, a deaf representative now sits on its Deaf Equipment Acquisition Fund Trust Committee that oversees fund expenditures and revenues. The contractor (AT&T) hires deaf people as first-line managers, although improvements could be made to hire higher level deaf managers. This can be a good input area from within a relay system. Because the contractor is a private business, it does not require advisory boards. There is none in California, resulting in little or no direct input from deaf consumers at the board level. AT&T has remedied this with the establishment of advisory boards in New York and Alabama. In Maryland, the Department of Health and Human Services will have an advisory board with five deaf consumers, four telephone industry representatives, and two representatives from the state government.

Other possible mechanisms for organized input include state government advisory boards, state commissions on deafness/hearing impairment, state associations of deaf and hard of hearing consumers, telephone industry advisory boards, and trust fund committees.

Consumers' Perspective on Standards

The National Association of the Deaf is in the process of developing recommended standards for relay service. These tentative recommendations are subject to change. We welcome comments from any and all parties on the content of these standards:

- Advisory boards should have a broad representation of members and must include a significant number of deaf consumers.
- To ensure confidentiality, there should be no paper or electronic copies of conversations.
- Operators should be able to interpret American Sign Language-like text into English form and should be able to type at least 60 words per minute.
- Operators should be trained in deaf culture and deaf awareness as well as in confidentiality issues such as sensitive conversations.

- The blockage rate, or rate of successful telephone contact with a relay service, should be equal to standard voice telephone contact with operators. A blockage rate of one in 100 would result in consumer satisfaction when accessing operator or relay services.

- The advisory board should be responsible for consumer evaluations of services. Internal evaluations by relay service providers will help with planning any changes in relay operations, utilizing consumer input from the advisory board.

- Because telephone customers have a toll-free number to access and request operator assistance, the same should be true for accessing relay services. Users of relay services should pay only for calls made from the originating point to the party dialed, and should not be charged for dialing to the relay center.

- All states should include interstate calling provisions in their statewide relay programs. Relay users should not be treated any differently than other telephone customers.

- Special accommodations such as a time-delay arrangement should be made for tape-recorded calls such as 976-line calls. If a type of relay call is restricted, it is not considered "equal telephone service." If any restrictions are placed on calls, support from a consumer advisory board would be necessary.

- Procedures for filing a complaint with the relay service centers should be similar to those for voice calls. A separate toll-free number should be available for TDD relay consumers and voice relay consumers so they can call directly to file complaints.

- It is better if one vendor is responsible for relay services because consumers can better address problems with performance to one vendor than to multiple vendors. A regional center serving several states would be acceptable as long as there is one vendor in one state. An ideal situation would be for one vendor to serve the nation's relay needs, making it easier for deaf people who travel frequently across the country.

- All local telephone books should have TDD relay phone numbers easily identified in the first few pages. Billing inserts with relay service information should be distributed at least twice a year.

- Television and newspaper advertisements should educate the public about the availability of relay services. Consumers with TDD numbers should be included in a separate directory within the local telephone book for easy identification and reference.

The Future

States across the country vary greatly in performance standards. Some standards, such as public information, are uniform, but many are not. The challenge for the next five to ten years in developing a nationwide TDD relay system with uniform standards is to implement a participatory decision-making process. We all have a responsibility to see that standards of relay services are planned, maintained, and decided by a participatory decision-making process.

And yet, there are still some questions about standards. Should the federal government be responsible for regulating performance standards? Should we plan our planning and maintaining stages of relay system development where we include organized input to ensure high performance standards in states?

My five-year observation of nationwide TDD relay system development in the United States tells me that I should bet my dollar that such a system will be in place within the next three to five years. I know I will win that bet, and the winnings include that $300 annual savings on insurance premiums I could have had if a nationwide TDD relay system had been in place in 1981.

QUESTION AND ANSWER

Comment [Eleanor Letcher]: I am executive director of Contact, which has provided Deaf Contact, a dual party relay service, for eight years. I would like to comment on the role of volunteers and [nonprofit organizations] in providing services which heretofore have not been provided by government. I would like to have this conference fully recognize the role that volunteers have played in providing Deaf Contact and other relay services. There are approximately 50 Deaf Contact centers in the United States, most of which are

available 24 hours a day without limitations. Many of them are difficult to access because people are on the phones; but I think that we have played a very significant role, and I would like that recognized because thousands and thousands of people across the country have devoted many hours to developing these services and also raising a level of awareness of the communication difficulties of the deaf.

Answer: *Muchas gracias, amigos.*

Moderator: In Paul Singleton's paper, he did praise the efforts of the volunteer services that have done exactly what you said--raise awareness and provide services for the hearing impaired community.

Comment [Judi Bauer]: I noticed in the paper, you said there was a separate number for complaints. I would like to stress that strongly. What we are finding in Ontario is that, because deaf people are frequent users of the system and the operators get to know them and know their names, they are quite worried about making a complaint to the supervisor in the center itself because they feel they won't get as good service. So I think there should be a separate line for complaints.

PANEL: RELAY SERVICE OPERATIONS*

PANEL:**

Börje Nilsson
Esther Schaeffer
Phyllis Shapiro
Robert Tolensky

[Editors' Note: Panelists were asked to respond, from the viewpoint of relay operations, to the standards of service outlined by Paul Singleton.]

Robert Tolensky

Just reviewing what Mr. Singleton was talking about before, I guess the item that seems to generate the most discussion is blockage rates, and what deaf people or hearing people expect when they call the relay center. I guess what he is meaning here is that at times you do have to call through more than once. Sometimes it may take two and three times at peak periods during the day. One of the solutions is you bring in more operators, and on the surface, that seems like a very easy thing to do--except for the fact you have to train operators. In our situation in Canada, we originally put in ten positions. We grew to 20 positions. We are growing to 30 positions. There are problems in getting the space, problems in getting the equipment, and problems in getting the operators. As we heard before, you want to get good operators, and you have to bring them in and train them.

I don't think there is anybody who would quarrel with the fact that people using the relay centers should have a reasonable level of service, but I think that because relay service is so new and still growing it is very, very difficult to put a handle on how many times someone has to call in. I think we will all agree that something should be done, but I really believe it is kind of early in the game to establish how we are going to set those standards and what those standards should be. That's the item that gets my attention the most.

Another one was typing speed of 60 words per minute. Especially with the [existing TDD] machines, a customer cannot read when an operator is typing at 60 words per minute, and we have complaints from some of our customers to slow down because the operator is going too fast.

Phyllis Shapiro

I was also concerned with the blockage as was described in Mr. Singleton's paper. I'm not quite sure

* This is a transcript of a panel presented at the conference. Because the conference was captioned, the text could be saved and edited.

**Börje Nilsson, Telekontoret--Kalmar, Sweden
Esther Schaeffer, Telecommunications Exchange for the Deaf, Inc.--Great Falls, Virginia
Phyllis Shapiro, California Relay Service--Woodland Hills, California
Robert Tolensky, Bell Canada--Toronto, Ontario

of what the definition of it is there; however, if I am interpreting it to mean that 99% of the calls that come in should be answered and handled, then I guess I would have a problem with that. What kind of rest period time do you give the operators handling the calls? AT&T has long been in the business determining what average occupied positions should be. You can't keep someone typing at the rate of 60-plus words a minute or even 35 words a minute without just a little bit of rest period built in there, whether it be just to take a breath or to make out billing information. It has been one of our concerns--that we don't keep them too busy all the time. We attempt to answer our customers within a ten-second time frame, upon which they reach the System 85 switch and their call is about ready to be answered.

One of the other things I was also concerned about was the complaint process. In our situation, we have found it very, very beneficial to have the subscribers and the users of our service be able to call in immediately after having had either a good situation or a bad situation. That enables us to identify the communications assistant that handled the call and take whatever corrective or training action is needed at that time rather than wait and get it two or three days later. Then all is lost and its effectiveness isn't nearly as good. Also, we do take surveys of our customer base and what their reaction is to our service. That's also very critical in determining standards.

Esther Schaeffer

In looking this over quickly during lunchtime and looking at Paul's standards, I, too, would have a problem with the blockage rates. It's very difficult to accomplish that. To really do it, you need very expensive equipment, so there's a cost involved in the equipment that's necessary to actually help us determine how many operators we need. Then there's the problem of being able to get that many operators and to get them fully trained and up to speed to be able to meet that standard.

I do, however, want to say that I think that's a goal, a long-term goal for relays to work towards; but perhaps it should be augmented in stages--perhaps begin with a [less favorable] rate and then improve. The other area that I want to quickly touch on is the complaint procedure. We, too, encourage people to call immediately after they have a problem with a call because we also have the ability to go back and find out what happened with that call right then and there. If they wait a while, it's hard for us to reconstruct it, and it's hard for us to find out what really happened. It becomes a lot of guesswork and assumption.

However, I would like to add that we do have a formal complaint process. We have a board of directors and an advisory board. For each area that we serve, Maryland, D.C., and Virginia, we have regional advisory councils. If you are a consumer and you have a complaint, and you don't choose to come directly to the administration, you can go to your advisory council, which will discuss the problem at a council meeting, and I don't even have to ever know who actually brought that complaint. You can remain anonymous. If the advisory council feels that it warrants attention, they fill out what they call a position paper, and it means that I have to respond. They forward that paper to the advisory board, which then brings it to me. If necessary, if I can't resolve it myself, I can take it to our board of directors. But I must respond in writing, and I must tell them what action I have taken to resolve the complaint. So we do have a formal procedure in place, and I do think it's important that there be a real complaint procedure.

Börje Nilsson

I think I will show you some notes from our relay service in Sweden. We have some main goals for our work, and the first is when there is a desire for a new service, we must try to fulfill that demand as far as possible, and to the extent that technology allows, if necessary, with the use of provisional solutions. [This was outlined] in a letter from our director general to the Swedish Association of the Hard of Hearing in 1987. Also, text telephone customers, shall, as far as possible, have access to the same service as other telephone customers. That is our own objective for the Swedish relay service. The final area is that text telephone subscribers should be offered the possibility to communicate with people using ordinary telephones. To the extent that this facility is not provided automatically, it should be provided by an operator in a relay center. The operator's involvement should be strictly limited to transmitting and receiving exact messages without any obligation to resolve linguistic difficulties. About typing speed, we have said that about 700 characters per three minutes will be

necessary *[Editors' Note: about 39 words per minute]*, and that we will try to keep that level.

For the rest, we have not set up so many requirements, but deaf people in Sweden know where to turn if there are any complaints. They have their own methods, and we have made advertisements so they know where to telephone if they have any complaints. We also have a computer conference with deputies from the deaf community. They can ask questions and they can leave us information through that computer conference. I think we have good contacts with our customers so when the various complaints come in we very soon find out the problem and get it in order.

QUESTION AND ANSWER

Comment [Bill Cutler]: I would like to talk about sensitivity training for relay operators (or, as we call them in California, communications assistants, which is a little bit more professional). I have not heard anybody suggest that all hearing people involved in a relay system should go through the process of sitting in front of a TDD for half an hour and talking with his sibling about their mother having cancer...the process of typing complicated medical terms, the emotions that are inevitable. That would communicate some sensitivity that only those of us who are hard of hearing and who have tried to use a TDD would appreciate.

The main point I want to make is the relationship of hard of hearing people to TDDs and relay systems. There are many of us who consider ourselves hard of hearing and who have a discrimination problem that amplification doesn't help. Therefore we have to use TDD and relays. However, many of us are fortunate to have retained speech. It is important to be able (for those who can speak) to speak to the hearing party, and have the typed script only for what the hearing party is saying to you. This process has been mentioned several times during the conference--voice pass-through or voice carryover. I recognize that in order to make it a smooth operation, there may be some technology involved. I can't believe that it's impossible to resolve it. I have been using the technique with three or four of my telephone companions who happen to have a TDD and happen to hear. I have been using it for a year. It dramatically reduces the time that it takes for the conversation because only one of us is typing, and more importantly, you can communicate. You can be emotional. Your attitude--your voice can come through, and in this respect, it becomes much closer to a comparable telephone conversation. So I urge all of you to keep in mind voice carryover as a feature or standard of your relays as you set them up.

I predict that as relays and TDDs become more common, as the incidence of hearing loss goes up, you will find that the hard of hearing population will be using TDDs more. I can't predict how much, but this is going to have an impact on the market, I am confident.

Moderator: I would like to ask any of the people on the panel who might be willing or able to comment on voice pass-through or voice carryover. What is the capacity for providing voice carryover, where is it being offered and where not?

Answer [Robert Tolensky]: *I would be very interested in getting more information on how that would work. I guess there was some discussion about it a little while ago in our company. We felt that you really almost need two lines to be able to do it. If you have some information that would be helpful to us, I would sure appreciate it. [Judy Tingley: Four lines.] We looked at it, and I must admit that our technical people were not very optimistic about it. If anybody has any information--I know you said in California they are looking at it. Fortunately, California shares a lot of information with us, so hopefully we will get it through Phyllis [Shapiro].*

Answer [Phyllis Shapiro]: *We can do it today, but the way it functions mechanically today is not satisfying to all the parties involved. The hearing people and the operator involved in that kind of call, as we use it today with conferencing capability, can hear the TDD tones back and forth so AT&T has agreed to take a look at the implementation of new technology, if need be, to provide the voice carryover service. We can do it. It is just very awkward today.*

Answer [Esther Schaeffer]: *I would like to respond to that. There is technology in development that's in the early prototype stages--actually in a prototype manner functioning now--whereby you can have a modem with a switch. So that the hearing person doesn't hear the TDD tones, you kick the switch so the TDD tones kick in or kick out whenever you want them.*

It also has an added benefit for those at the relay service. Sometimes we get a hearing person calling us, and they ask us to call a deaf person. We expect that person to answer with a TDD, but it may be a hearing household member who answers the phone. Such a modem with that switch capability would allow us to stay on the line until we determined whether it was a voice-answer or a TDD-answer, and then switch the modem appropriately.

Answer [Karin Lindberg]: *More than 40% of the calls relayed in Norway are relayed with [voice carry-through] and only answered with text. They are just great because [the two parties] talk to each other. It is much better to relay that way, and why should they use text–people who can speak? The only problem is that everyone wants to speak themselves, [and some cannot be understood]. So I refer to my yellow book that states that if the hearing impaired person wants to speak, he can try two times, and if the customer at the other end doesn't understand, then the hearing impaired person has to start typing. We just have to state it very clearly because sometimes they get angry because they think they can be understood. But even if they can be understood when talking directly to other persons, you need a certain kind of speech to be heard over the telephone.*

The fact is that the equipment we use is not at all new. It is very old-fashioned. That's why we can provide voice carryover. And you mentioned a problem that you are never sure if the call is by voice or text telephone. Well, when we call, we hear the text telephone so we just switch over to the text on our equipment.

Comment: If all of you can consider the demographics of the deaf and hard of hearing population, you'll find that there are probably nine hard of hearing people for every one deaf person, and as the relay system grows, more and more people will join in in the future. [With voice carryover] you are going to see a tremendous amount of savings. For example, now I think the average length of the relay call is about seven minutes and the average cost of the relay call is from $5 to $6. So you can see the tremendous amount of savings that could occur if the time of the call was cut almost in half. Also, it frees up more operators so that the blockage rate is much less. I think it is one of the most important areas for us to work on.

Question: I would like to get back to the issue about what is legal and what is not legal over the telephone. There are two areas of concern. I know that I would not know what to do if there were drugs sold over the phone. One person stated that usually the operator has enough legal knowledge to decide what is legal and what is illegal–to the point where they say [if you are doing something illegal] you have to hang up. Do operators have that kind of knowledge? I don't think that they have that kind of knowledge, and so I have a concern about that.

My second concern is the liability involved with this. What if I don't think that the relay service should have the ability to make those kinds of judgments about whether a call is legal or illegal? I think that they should just serve a relay function and that should be the end of it.

Answer [Phyllis Shapiro]: *The Public Utilities Commission in our state indicated that the operator in no way should pass judgment on any kind of call that is handled. To give you an example, a common phrase used when referring to curing marijuana is "to cut the grass." Who am I to say that these two people talking are really talking about cutting legitimate grass on their lawn? My way of thinking, I may think that is marijuana, pass judgment, and then someone is in trouble. It is not up to us to pass that kind of judgment. We are out of the call. We are just a bridge between these two people. I can call anybody because I am hearing and say anything I want of any context whatsoever, and no one is listening to that call or passing judgment on me. We, in California at least, subscribe to not passing judgment on any part of the call. It is their call, and it is up to them to handle it as they wish.*

Answer [Esther Schaeffer]: *We are not a statewide relay service and since we serve the Washington area, we are talking about three jurisdictions anyway. It is difficult to tell when something is legal or not legal. We only terminate a call if we are convinced beyond a shadow of a doubt that that call is really illegal. That happens so infrequently because we really are not in a position to judge that; it probably doesn't happen two, three times a year. You're talking about something that occasionally happens when we blatantly know it, but it is really not an issue. It only happens once in a while, so you are not really talking about something that is really an issue.*

Answer [Robert Tolensky]: *Fortunately, it hasn't been a major issue with Bell Canada either. It is a gray area. If the illegal act involves bodily harm or harm to property, that is an easy decision to make; we are not going to participate in that act. When we go to the kind of example that Phyllis gave us with "cutting the grass," our operators are getting more experienced. They do have a supervisor who is supposed to be more experienced than the operator when these situations arise. There is a manager in the office who is also available to make these decisions when they are in a gray area, and fortunately, we haven't encountered a situation where it has become a major issue. I don't think there is anybody in this room who would be able to sleep at night if they participated in an illegal act which would cause bodily harm or [help] someone [in] planning a bank robbery. Our operators are human, too, and they don't want to participate in that.*

Answer [Esther Schaeffer]: *At TEDI some years ago, we were actually party to a telephone call in which bodily harm was threatened, and bodily harm did occur. It was such a gray area that we, in fact, did not take any action. Ever since that time, we've known that we had some knowledge about it because that call went through our service. Yet we felt at that time that we were bound by the code of ethics not to be able to do anything about it. I would agree that is really a gray area, and it's an area where a relay service really has to think about it. You have a moral obligation. It's very difficult for us to determine if somebody threatens bodily harm--is that a joke, do they really mean it, or are they just teasing around? And again you could say that is not for us to judge, but what happens when something really happens and we had knowledge? [In our case] the person didn't die, but the person was harmed. Could we have stopped it? That's a very awkward position for the relay service to be put in.*

Comment [Judi Bauer]: I would like to raise two issues. I work for the Canadian Hearing Society [CHS]. Before we had the Bell relay service, CHS provided a volunteer relay service. We now think it's a principle that the telephone company should provide the service, if at all possible. It should be a right of deaf people to have equal access to the telephone, and the only way that can happen is for the telephone company to provide the service. We had all those volunteers who worked hard and did a good job and were very sad to see their jobs go to telephone operators. But we felt, and it was the deaf community that felt most strongly, that it should be the telephone company. I'd like to hear some discussion about that.

The second thing is the involvement of the deaf community and how to do that. When the phone company takes up the service, the big problem, of course, is they don't know anything about deafness, and they don't have a lot of contact with the deaf community. As Bob [Tolensky] talked about, we had an advisory committee which helped Bell to develop the service itself. There was a majority of deaf people on that committee, and it met once a month to develop policy on legal issues like confidentiality and many other policies. It also developed the training procedures. We feel that it is very important--not only for monitoring, but to develop policy for the service--that there be a majority of deaf people on the advisory committee so it meets the needs of the community. It helped Bell to develop this service as well, and it wasn't a negative thing at all.

Question: How do you initiate a call when you receive a call from a deaf person [calling] a hearing person? What method do you use to introduce yourself [to the hearing person]? Do you instruct all your consumers to type in they are working through a relay operator and this is not them speaking? Or do your relay operators have a standard greeting to introduce themselves and what is going on?

Answer [Esther Schaeffer]: *Some of our operators have been with us so long and some of our users have been users for so long that we actually know some of the people; we have made calls between the two parties so often that often we know that no introduction is necessary. In that case, we just say, "This is Telecommunications Exchange for the Deaf. I have so and so on the line. Please hold while I get their message." Suppose we are calling a business, let's say a car dealership or some kind of an insurance company or some other place that doesn't know the deaf person. We then very quickly tell them that we are a relay service. We are speaking for the hearing impaired person, and we are going to type back exactly what they say--in about four sentences. We try to condense it all because we don't want that long pause on the line, because what seems to us like maybe ten seconds, to the deaf person sitting there waiting for the call to go through is like an eternity. Often enough we get transferred and put on hold, and*

we have to keep you informed of that. We try to make it as quick as possible but alert [the hearing party] that the call is coming through the relay service. If they ask questions about it, we ask them to stay on the line after the call is finished and then we explain the relay service, but we do that after the call is completed, not during the call.

Answer [Phyllis Shapiro]: *When the California Relay Service initially opened, we faced the need to educate the hearing world about what we were all about, and so as an overlapping procedure, we would give a mini education to the hearing person by saying that this is the California Relay Service. We briefly instructed them that they must remain in the first person, talk directly as if they were talking to the party, and that we would be typing what they said. In the meantime, the operator was letting the deaf customer know how the hearing person answered. The operators are trained. They need to type in, "Hello. This is Dupont. Go ahead." They need to do that because our ultimate goal is to just be able to handle the call as if it were going from person A to person B without anybody on the line having to say, "We are the California Relay Service."*

Sometimes the hearing person gets stuck and confused and maybe hasn't gotten a call from us before and will say, "You're not John!" Then we will go into a brief explanation of who we are. Again, the call is kept flowing as we give that brief explanation because the ultimate in relay call handling is, in fact, to handle the call in that way. There is a lot of education out there needed for the hearing world.

Question [Cindy Carter]: How would you handle the sexually explicit calls that come on that 900 line if you have an operator who really does not know how to or want to handle this call? What are our legal rights about handling calls like that? Can we decline to handle them? I feel, if the content is not illegal that I would actually tell the caller that our relay service is not capable of relaying this call unless they first pay for it. Can we legally do that?

Answer [Esther Schaeffer]: *As long as the call is not illegal, we can't refuse to place the call. We will place the call. Now, if the operator finds handling that call objectionable, for whatever reason, we do not force an operator to handle a call that they don't feel comfortable handling. We ask them to just tell the person to hold a second, and then we either switch that call to another station, or one of the staff takes that call. But we do, indeed, as long as it's a legal call, we process it. We have just found that it's going to make better community relations among the operators if they are not forced to handle something they don't feel comfortable with, and normally we have enough people around and a staff person around that they can take that call, so we go ahead and handle it.*

Answer [Phyllis Shapiro]: *During the interview process, our people are told that they are going to have to translate calls that may be of an explicitly sexual nature or obscene, profane, or what have you. We really have not had any experience with anyone who has had a hard time doing that. They had that understanding at the outset that that's what they are going to have to do and that is part of their job. As far as 900 and 976 calls are concerned, part of that order in the state of California was that we would not complete calls for 976 numbers, whether they be of a sexually explicit nature or are sports lines. If it is 976 or 900, we don't call it; however, there are ways that the deaf community and hearing community have found to get around that. There are other sexually explicit lines that are not 976 and not 900, so you still get the calls. Whether you want it or not, through 976 and 900 what we are talking about here folks is equal access. I'm hearing, I can call wherever I want and say whatever I want. That, again, is an ideal portion of relay. That's our objective, not to pass judgment.*

Answer [Robert Tolensky]: *We also don't connect to 976 in Canada, but I do understand there is some very sexually explicit information being passed between couples, and it should come as no surprise that some operators love handling those calls. And some of them hate it, but there always seems to be someone in the office who is willing to take it!*

Question [Francine Lauer]: I am addressing the question to all of the panelists, but I guess especially to [Esther Schaeffer of] TEDI because it has already been answered by some others. Suppose I'm making a long distance call, and then the call is relayed and you explain to the person being called what your system is doing; I didn't volunteer that information, so does that cost me on my [long distance] bill?

Answer [Esther Schaeffer]: *Our comments last only several seconds, at most, and we make a policy of not [explaining the relay process during] long distance calls. We just get the party. We tell them we have you on the line, and if any explaining has to be done, we let you do it. We don't waste your time and we don't charge you.*

Question: I find the operators are inconsistent. Sometimes they will tell me I have a busy signal. Then they put me on hold and the phone is ringing one, ringing two, three, four times, and then they say your party is busy. I need to have a feel for what is going on on the other end of the line.

Answer [Esther Schaeffer]: *When the phone starts to ring, it is now built into our computerized system that we hit a button and it starts counting the rings. The reason we do that is oftentimes the deaf person says, "You didn't let it ring long enough." The system is built in so that it actually counts the ring for you, and the minute there is an answer, it stops sending that message and it stops counting. Our system will also automatically tell you the line is busy. Sometimes you may find it inconsistent because it may be a new operator, and there is so much for them to absorb. It is like we all say, we haven't reached perfection yet.*

Question [Ed Kirk]: I realize some relay systems might be able to negotiate volume discounts with long distance providers. But on the other hand, we also have equal access requirements in this country. In California and Canada, I was wondering whether you decide which long distance company you [use to] complete the call, or whether your individual caller presubscribes to a long distance carrier?

Answer [Robert Tolensky]: *In Canada it is quite easy. You have no choice [of long distance company].*

Answer [Phyllis Shapiro]: *It's possible some of our subscribers have that access or have subscribed to MCI, Sprint, etc. We have no way of accessing that network from the relay service. In essence, we are like Canada. They go over the AT&T network right now. It is a question that has come up before. Technologically, I don't have any way to access MCI or Sprint right now or whatever their carrier might be.*

Question: Do you have just one relay center in the whole state?

Answer [Phyllis Shapiro]: *Yes.*

Question: So no matter how many LATAs away someone is from you, they are routed through their long distance provider?

Answer [Phyllis Shapiro]: *Through the toll-free 800 service.*

Question: And you route the call over your choice of long distance carrier?

Answer [Phyllis Shapiro]: *Which is AT&T, yes, that's correct.*

Question [Stuart Brackney]: I have a semi-moral question to ask. In Arizona, the caller has a right to instruct the relay operator to not identify him or herself as a relay operator when the called party answers the phone. So it can be the voice caller saying, "Operator, don't identify yourself as a relay service" or it can be the TDD caller making that request, and the relay operator must comply. Now you have second party on the line, the person called. Is there an obligation--and I'm wondering if it's done in California or up in Canada--is there an obligation to inform that called person, person B, that there is a third person involved in this conversation? That is, if I have a private conversation, not knowing that someone else is involved in the conversation, I might breathe easy with my choice of words. Knowing that a relay operator is in the middle, I might, because I don't care what anybody says about confidentiality, I just don't feel comfortable saying the things I would say because I have a relay operator in the middle. Back to my question, is there an obligation for the relay service during some point of time during that conversation to identify that there is a relay operator involved in this conversation?

Answer [Phyllis Shapiro]: *No, at least not from California's act. Remember, it is their call. To give you an example, when we first opened, we had a lot of trouble with banks. Suppose a deaf man wants to call and get his balance in his checking account. Here I am, a female, and I am saying, "I am John Jones," and the guy at the bank is saying, "Wait a second, you are not John Jones. Who are you?" I type exactly what the guy at the bank says. And then it is*

up to the deaf customer to stay in control of that and say, "Never mind who I am" or whatever he wants to say. If he wants to say he is calling through relay, then that's cool. That is my instruction as a relay operator: It's the customer's call.

If I called someone and didn't wish to identify myself, I wouldn't have to do that. If the person I'm calling wants to hang up on me, that's fine, too. That happens at relay also. If a called party doesn't want to talk unless they know who it is that's calling, they have the option to hang up. And sometimes they do, but again it is the deaf subscriber's call or the hearing person's call. Whatever I hear–I don't care if it is, "This person is crazy" or "What in the hell is going on?"–is going to be typed. The hearing person is notified that their words will be typed, if they ask. The situation that Stu [Brackney] has presented to us, that is typed.

Comment [Charles Estes]: I have been listening for two days about the training in ASL [American Sign Language] and deaf culture and so forth. I think this conference should make a strong recommendation to the U.S. Department of Education to develop a new regional training program for relay operators.

PLANNING FOR STATEWIDE RELAY SERVICE

Joseph B. Heil, Jr.[*]

This conference provided a forum for knowledgeable individuals to focus on the various aspects of relay systems, including advocacy, legislation, financing options, and performance standards. This paper is meant to function as a "check list" or "road map" to identify areas the author feels should be revisited or explored further when seeking legislation, designing, planning, implementing, or operating a relay service.

For this know-how, the author is calling upon experience gained from a long career in the telecommunications industry, more than 13 years observing the progress made by deaf people to attain equal access to the telephone network, and four years as an independent consultant to clients involved in communications for persons with disabilities.

Getting Started

Relay service is the major telecommunications service currently sought by deaf people in the United States. Leaders or "prime movers" in the states that have enacted legislation or obtained regulatory mandates have been successful when deaf people were involved and when deaf people provided data to support their obvious needs. Well-designed and thoroughly explored strategies, supported by accurate data and individuals who are prepared to respond to inquiries, are paramount to obtaining legislative or regulatory support.

Success does not just happen! Those who have been successful have invested many hours in getting to know the "right" people. Key legislators and their staffs have been invited to meet with deaf people to learn, first-hand, the important role they can play by introducing and bringing needed legislation to the floor for a vote--and securing its passage. Total dedication is needed. Too often legislation is introduced but then flounders without the legislative follow-through needed to call the bill to the floor for a vote and passage.

Data--A Key Component

Recent experience has demonstrated that estimates of the number and location of TDD users as well as estimates of calling rates are vital components of effective planning. Reliable data must be identified, accumulated, validated, and translated into call-data upon which costs can be projected.

Growth estimates or projections are critical to the process. The California Relay Service anticipated growth and provided facilities and personnel to handle the projected increases in volumes. California's original projections were exceeded within the first eight months of operation. First-year projections of 60,000 relay calls per month were quickly surpassed, and by August, 1987, (after seven months of operation) volumes reached 180,000 calls. In June, 1988, the monthly volume had swelled to 225,000 calls.

Arizona experienced similar growth, with initial estimates for its Merlin PBX being exhausted in the fifteenth month of operation. Additional funding for more telephone facilities and staff had to be obtained through the legislature.

It would be easy to explain the unprecedented volumes as inadequate planning. A more realistic explanation might be that a rapid and unexpected growth in demand resulted from customer acceptance and satisfaction with the new service, coupled with the

[*] Joseph B. Heil, Jr., Consultant, 47 Ralph Place, Morristown, NJ 07960

sudden freedom to place a call when needed, not only when they were able to penetrate the busy signals or find an interpreter. Several observers, including the author of this paper, thought the original planning estimates were valid because they were based on the volumes of calls handled by the existing relay centers and included a factor for the number of calls receiving busy signals. Both the California and Arizona experience have demonstrated that current usage data and busy signal/line data are essential to identify calling patterns and, perhaps, time-of-day distributions; but to anticipate growth, new data are needed for accurate projections. Planners should understand that until the deaf users' calling rates match those of other residential telephone customers there is every reason to expect the volumes to expand rapidly, as the callers experience a new type of service and availability while experiencing a new sense of freedom to place calls.

Experience in California has yielded data which might go unnoticed, but which should be included in planning estimates: 20% to 25% of the calls currently processed originate from non-TDD users (hearing people).

Relay service is labor-intensive and requires costly telephone facilities. Since these costs are directly related to projected call volumes and number of users, dependable data must be available to translate into costs.

This planning is essential to avoid the crisis which will occur if growth exceeds the planning interval, making initial funding inadequate. Funding shortfalls can cause political problems. Similarly, an overstatement of volumes and costs can adversely affect legislative support.

Utah provides a classic example of what can happen when limited or less-than-complete data are presented in support of legislation. A bill introduced in Utah mandated both TDD distribution and relay service. Using the surcharge currently in effect in California as a model (at that time the California Trust Fund had a surplus), the authors of the Utah bill specified a maximum surcharge of three cents per access line per month to fund both activities. The stark reality is that Utah has fewer than 700,000 access lines, resulting in revenue of approximately $250,000 a year. This amount was insufficient to introduce both programs at the same time.

By contrast, the recently enacted bill in Alabama does not prescribe a maximum or cap, but instead gives the Public Service Commission (PSC) authority to set the amount of the surcharge needed.

When estimating call volumes, numbers of users, and calling rates, the planner must make these projections from *realistic* data. Reliable demographic information concerning the number of deaf individuals and TDD users in a state is difficult to obtain and validate. These data can present wide variations, depending on the sources of the data. In the past, those seeking funding for a variety of deafness-related activities and services have estimated the number of profoundly deaf individuals in a given state by using the prevalence rates contained in the National Census of the Deaf Population (Schein and Delk, 1974), applying them to that state's population.

Recently, staff from one state office were asked how many deaf people lived in that state. The reply was that their best estimate was about 35,000 profoundly deaf individuals in their state. The same office provided the telephone company count of the number of households which had applied for the intra- and interstate rate reduction. The total was fewer than 800.

Even if there were an average of four deaf persons per household, which is probably high, and adding a factor for deaf people who do not have TDDs, the result would surely be less than the projected 35,000. This is not an isolated happening.

People who are asked to provide these figures often have only these data available to them. California advocates, testifying at the early TDD hearings before the California Public Utility Commission (PUC), opined that the profoundly deaf population in California was 225,000. A survey commissioned by the telephone company estimated that 49,000 people would come forward for the TDDs. The PUC staff, to be on the safe side, estimated 90,000. After five years of distributing TDDs (including a number given to agencies), total distribution to date is fewer than 20,000 units.

Since the start of the California Relay Service, there has been a noticeable increase in the number of hard of hearing individuals who are requesting TDDs from the California program. Advocates point to the services which are now available via TDD and the California Relay Service as a reason for this increase. Subsequent planners will want to take note, especially when their states have a TDD distribution program.

Arizona may provide a contrast. Using the experience of California and the data available from the California TDD distribution program, Arizona developed estimates for the number of TDDs required for its program. These estimates have fallen within 1% of the number they have distributed. This formula may have

some application for those who are attempting to develop potential TDD user information.

The Existing versus the New

When legislation is proposed or enacted to provide broader relay services, some relay service providers view this action as the solution to all their problems: money, which can be translated into additional force and facilities. Existing services may even view themselves as the "heirs apparent" and contend they are the logical groups to operate a statewide relay service. They describe their services as "personal" and "caring," and state that they know the local people and their needs, thus suggesting they are better qualified to operate the relay serving their community.

Many existing relay services are subsets or one facet of agencies providing a variety of services to deaf clients. Relay services have evolved from an expressed need of the agencies' clients. A number of relay services have been established through joint community action. Volunteers are sought to work three to four hours a month or longer. Funding is raised from a multitude of community fund-raising activities. A portion of the funding may be provided by state or municipal agencies and United Way organizations. Generally, all are faced with the same problem: less money than is required to provide the level of service needed. Some report ongoing difficulties obtaining volunteers.

While most local relay services excel at providing a highly personalized service under difficult situations, few have the resources or expertise to operate a large-scale, statewide relay service. In many states, deaf individuals have been quite vocal when expressing a desire for relay service operated by people who are not part of the established deaf community or by the agencies which serve them. They point to their concern for privacy and insist on the anonymity of the relay clerk.

Furthermore, an agency may not have the financial resources necessary to provide the capital required for rapid growth and expansion, or to cover the increase in operating costs which must be incurred and paid for before reimbursement. Existing relay services provide a logical starting point for the planner. Frequently, the question arises: Should we have one or more than one relay center? The rationale offered for multiple relay centers may range from the desire of existing relay providers to be a part of the final service, a desire for local control and supervision, or a technical concern that the local nature of relay calls (calls originating and terminating in the same local area) may suggest serving locally, thus using less costly local access lines rather than costly toll lines to carry messages to and from a more distant center.

The latter item prompts important questions which should be addressed in early planning: What are the traffic patterns for relay calls and how can they be handled in the most cost-effective manner?

To answer these questions, data (and some good guesses and projections) will be needed to determine the number of TDDs and to identify call data by region. In most states, the main deaf populations are concentrated in identifiable areas. Proposed solutions will have to include costs of the alternative.

Equally important will be the need to provide a uniform level and quality of service while making the most economical use of larger team sizes. In less technical terms, there must be a comparison of the costs and savings associated with each proposed strategy as well as the effect multiple centers will have on achieving standard service performance.

The Role of the Consumer

Legislation introduced and enacted since California's often has included a requirement for the deaf community to be involved in the planning, contracting, personnel selection, operational oversight, and control of the ongoing operation.

While these provisions have their origins in advocacy and a desire by deaf people and their leaders to control their lives, services, and environment, a strong business case can likewise be made for having consumer involvement from the beginning. Obvious benefits are present when seeking legislation or regulatory action. Performance standards must begin with the consumers' perception of the service. Deaf consumers are in a unique position to provide guidelines and even participate in developing training information on deaf culture and deaf language. Many people familiar with the deaf community and its culture will agree that having deaf people conduct this training is a must for a better understanding of the consumer.

After five years of continuous effort by major deaf advocacy organizations and after recent funding inquiries, the California PUC has added a disabled person to the board which oversees the Trust Fund. Hindsight being 20-20, this action should have occurred earlier and should not have required an ongoing hassle for five years.

Whether or not an oversight committee is specified in the legislation, it is good business to have consumer

representation on the board or committee which will be evaluating performance, mediating disputes, and reporting to appropriate legislative and regulatory groups on the performance, management, and needs of the statewide relay service. A consumer advisory panel or committee can provide valuable information to those who manage the relay service. It can provide a link with consumers and can give meaningful feedback on the quality of service, based on the perceptions and needs of those who use the service. A consumer advisory committee must have assigned duties with defined responsibilities. Management must reply promptly to the committee's observations and proposals.

Both the Arizona and California relay services have established a standard of performance for relay services. These standards provide a starting place for anyone planning a new statewide relay operation.

Another bench mark is the policy of the New York relay service to relay interstate calls which originate or terminate in New York. Experience in New York will provide new data and information about this aspect of relay operations.

Standards for Relay Service

Consumer expectations and perceptions of service create the standards of performance for relay service:

- Twenty-four-hour operation, available when needed.
- Minimum time delays getting a response from the relay clerk. (Standards on delay should be comparable to telephone standards for operator responses.)
- Responsive and skilled personnel and management.
- Accuracy in conveying both sides of the conversation.
- Confidentiality, with no hard copy or computer memory maintained.
- Staffing by people who have an understanding of deaf culture and language.
- Involvement of deaf people in planning and operational oversight.
- Quality assurance procedures to evaluate intangibles such as courtesy; typing accuracy; and manner, attitude, and tone of service providers.

Financing Alternatives

Several early relay services (Connecticut, Texas, South Dakota, and others) have been funded by state agencies with relay costs shown as a line item in the funding agency's budget. Of course, these budget allocations are subject to the annual budget process, and sometimes subject to across-the-board budget cuts. There are also questions as to whether the agencies could provide the immediate response and funding needed when unprecedented demand or growth occurs. Connecticut initially operated a 24-hour relay, but its contractor, Converse Communications, had to cut back hours of operation because of budget cuts.

Most relay legislation specifies a surcharge on access lines to finance the relay service. Since the financial "crisis" related to the success of the California Relay Service, recent legislation has avoided specifying unreasonably low caps on the amount which can be charged. A recent bill passed in Alabama directs the Alabama Public Service Commission to establish the amount of the surcharge needed to be collected by the telephone companies, and to implement the dual party relay system within the state.

A landmark decision by the New York Public Service Commission (NY PSC) may offer a solution to financing of a 24-hour statewide relay, with interstate calls, standards which are comparable to other telephone services, and sufficient funding to respond to rapidly changing volumes. This solution avoids identifying the charges as a "deaf service" on phone bills. The NY PSC ordered all telephone companies within New York to provide relay services, including the costs of the relay in their regular rate base cost recovery system. The PSC authorized the telephone companies to contract with AT&T to operate the relay service. The NY PSC decided that each telephone company would pay a prorated share of the costs, based on the company's percentage of total access lines within the state. The telephone companies can provide not only qualified technical and operational supervision of the relay service, but also skilled analysis of the costs.

Since this action by the NY PSC, advocates in other states have sought similar support from their PUC or PSC staffs. When advocates quoted the NY PSC action,

some staff replied that their states did not have the authority to order similar compliance by the telephone companies. It may be necessary to seek state legislation to give the PSC or PUC the authority needed to provide equal access. Prior support or agreement from the PSC or PUC could help expedite passage of the legislation.

Selection of Vendor(s)

When a planner reaches the point where a vendor or vendors must be identified and selected, many questions must have been addressed and, hopefully, answered correctly. Scenarios must have been prepared based on available demographics, call data, projections for growth, and busy hour/busy day volumes. Then this data has to be translated into the number of work positions, telephone facilities, number of employees, managers and support personnel, and size of physical facilities. All of this must be specified to achieve the level of service established as an early goal.

The term "vendor" may convey different meanings. Often it identifies would-be providers of components of the system, components such as office space, furniture, telephone systems, network configurations, and a contractor to operate and manage the system. Individual suppliers may provide components while a single contractor may be responsible for the entire operation. If the bidding is done by components, there will be a need for someone with the expertise and experience to pull all of these individual contracts together to result in a successful system. Care must be exercised to fully evaluate a potential supplier's ability to perform. Staff must understand and evaluate the stated capacities of telephone PBX equipment, so as to avoid under-purchasing equipment which, when outgrown, must be replaced at a potential loss of the value of the original equipment.

Some planners believe there may be cost savings inherent in a local "do-it-yourself" approach. One planner was forced to go this route because the initial level of available funding did not permit contracting with a large telecommunications company.

If there is any bias in this paper, the author's almost 42 years of experience in the telephone industry causes him to look skeptically upon a system which would attempt to hold a number of suppliers and contractors responsible for the overall operation and efficiency of this type of system.

California and New York have contracted with a major telecommunications firm which not only operates the system, but provides ongoing technical and planning support to ensure the mandated response while attaining maximum operating efficiencies. One might argue that contractual language with segmented suppliers could ensure their compliance and the continuity of the service. Who would assume the burden of proof? How long would it take to repair or replace key components of the system or to restore service? Cost differences in the two approaches must be identified and compared with "what-if" scenarios. There may be some justification for costs which can ensure dependable service.

Consumer Involvement in Customer Instructional Materials

Consumer input and review is essential for instructional material and information going to the deaf community. Knowledgeable people can ensure that proposed mailings and advertisements recognize the culture in which relay users participate. Too many people who failed to include this input and review have learned that instructional booklets, press releases intended for the deaf community, and other mailings often have failed to achieve their goals because there was no understanding of language and deaf culture.

Conclusion

Planning and implementing a statewide relay service is a big undertaking. It is more complicated than just moving from a number of individual relays to a larger system. The budgets forecasted for California and New York demonstrate that relay service is a big business. As such, specialized knowledge, skills, experience, and training, which may have no relationship to existing relays, will be needed.

By no means is this paper the only way or the last word. If it has you take a second look at a problem area, pose additional questions, or gather better data, the author will have achieved his goal in the limited space available.

QUESTION AND ANSWER

Question [Sheila Conlon-Mentkowski]: You talked about the increase in the number of TDDs distributed in California [after the relay service began operating]. I point out that there was a 12% increase. In

Maryland, one of the members [of the Commission for the Deaf and Hearing Impaired] did a study of a medical center that she worked with in the city of Baltimore. I think that you might find these statistics true of any metropolitan area in the United States. This medical center served 400 deaf people. It was found that, of the 400 deaf people, a very small percentage, I think only 40% of those people, had TDDs. They were asked why, and 60% [of those without TDDs] said it was because they couldn't afford them. Maryland does not have a TDD distribution program. We tried to set one up. The legislature said it was too expensive.

Answer: *You raise a very good point, Sheila, and I almost overlooked it. When you start comparing California against other states, you have a couple of unique variables there. I don't know how you quantify them, but you have to recognize them. When relay started, California had about five years of a program of distributing TDDs, and people had had five years to learn of their value. In another state that did not have such a proliferation of TDDs, the volume of calls in the relay service might not be the same.*

Sometimes people seeking the legislation are required to distinguish between giving TDDs to everyone versus giving them to people who cannot afford them. I think Charlie [Estes] faced that in Oklahoma; they had a rider that says there must be a sliding scale. In Oregon, their TDD bill was a milestone. One of the big objections by a lot of low-income deaf people is they cannot afford the $100 or $120 to put the telephone in in the first place. They may be able to afford the monthly charges. Oregon said that the fund could pay for the installation of a service. I don't think the discount system identifies all potential TDD users, but it's a starting place for quantifying what you don't know.

Question: A part of the issue that we have not addressed here is regarding people who do have TTYs (or TDDs as everyone calls them), but who don't advertise in the phone book that they have one. When we talk about the relay services, and we talk about blockage, how much of a responsibility do we have, as advocates for improved communications for the deaf, to encourage people who *do* purchase TDDs for their businesses to advertise that number? It's a great source of dissatisfaction to find out after so much time that you have wasted, that [the person or business] has a TDD and it's not listed in the book. I am wondering if we can think of some ways to encourage people to list their TDD numbers in the phone book.

Answer: *Before divestiture, in some states, a number of the local telephone companies permitted a deaf individual to put in the phone book that the listing was a TDD number, or TDD-and-voice number. California was the leader in this. The only caution that the telephone company offered at that time was, if you list yourself as a TDD owner, that you don't list your address in the book. There is no sense in advertising for somebody to break into your house. It's currently in vogue to ask the companies to put a separate section in the phone book on TDDs. I think that is going to be a tough idea to sell. You can make sure that the telephone company will put "TDD" by peoples' listings at no charge.*

When you advertise in the Yellow Pages, *I can't imagine anyone investing in a TDD that wouldn't advertise it. I know of a major department store that put in TDDs and sent notices to the deaf community and then wondered why they never got any calls. I said to them, "In your ad in the paper, did you say, 'TDD users, call this number'?" And he said, "No, my advertising people won't permit that." [Members of] the deaf community are the best people to influence this. I could say to a person, "Put a TDD in," but if the deaf community goes to them...you are the numbers.*

Joseph Heil, Consultant

A conference participant asks a question following a presentation.

MORE QUESTIONS AND ANSWERS ON TELEPHONE RELAY SERVICE

For some of the conference topics, leaders in the field spoke but papers were not written. Included here are questions and answers following Esther Schaeffer's presentation.

Esther Schaeffer
President
Telecommunications Exchange for the Deaf, Inc.

[Editors' Note: Ms. Schaeffer spoke about operator training and community relations.]

Question: You mentioned that there is some information that you tell your operators they can give over the phone--information about the organization, for example. If your operators are requested to give their names--for example, if they are making a call to the telephone company and the telephone company insists that they have that person's name--do you allow them to release their anonymity? I've found from experience that the operator is then pulled into a personal involvement; a few days later the person from the telephone company calls back and says, "Well, I just talked to you a few days ago. Don't you remember what we talked about?" How do you handle that one when a name is requested of the operator?

Answer: *Some deaf people have also asked us to have our operators identify themselves when they take a call. We don't do that because the minute we give our name it takes away from [the deaf person being in control of] the call. Each of our stations at each of our offices has a code name. That name is a name that can be female or male. Like Ray/Rae--Ray can be a man's name or Rae can be a woman's name. If the operator is asked to give his or her name, he or she merely gives the code name for that station. We know who sits where at what time, and if a follow-up call comes in we can trace it back.*

Question [Barbara Chertok]: You were stressing the involvement of deaf people in the relay service, and you were talking about feedback, and possibly serving on your advisory board. Can you give us other suggestions as to deaf involvement?

Answer: *Yes. And I would like to give credit to Barbara [Chertok]. It was actually Barbara who called me up one day and asked to have a private meeting with me behind closed doors. I agreed to that meeting, and she gave me a list; she said the operators should do this, not do that, and so on. I wrote those things down, and I got to thinking about them. I thought, "You know that's a good idea, a quick little list of dos and don'ts." I took what she gave me and expanded upon that and added a list for the users. So that's really involvement right there. Involvement in training, involvement on our boards, committees. Our newsletter editor is deaf. Our treasurer is deaf. We have deaf members on our board. All of our advisory council must be deaf. I would suggest that you read the paper I wrote [available from TEDI at the address provided on the List of Conference Speakers] on getting involved with your local relay service. There are just unlimited ways to be involved. And there are actually paid positions you can get into. All the positions are not in a volunteer capacity.*

Question: If a deaf person wants to speak [for himself or herself], and just have a relay operator type what the hearing person says...I don't understand how that works. Second, where there are illegal phone calls or activities taking place over the phone, how do you keep away from the legal liability for that?

Answer: *To answer your first question, there is technology now in development that would allow us to take a modem, and with a switch box, actually push a switch, and it would kick the line back from voice to TDD. It would allow us--if you want to*

speak for yourself–to click the button and tie in the two lines. Technology is there for that. We can actually do that. I am strongly in favor of that because I really believe it will speed up the processing of the call. And it also allows that personal touch to get across.

In answer to your second question, about illegal calls. We get illegal calls, too. Usually they are in the form of drug pickups or dropoffs. They try to make buys over the phone. Believe me, in my eight years I have learned all of the terminology for drugs. The minute we hear any of those code words or anything that implies that it is a call of that nature, as an operator we cut in and tell them this is an illegal transmission, and we terminate the call. We don't cut them off. We tell them they have to get off, and what we tell them is, what they do is their own personal business, just don't do it through the relay because it is illegal. You are not supposed to do that over the phone anyway. There are certain things that are just plain illegal over the telephone lines. So that's the way we handle it.

Carl J. Jensema, Gallaudet Research Institute

Section II

REAL-TIME CAPTIONING

Carl J. Jensema, Ph.D.
Session Chair

Malcolm Norwood, Formerly of U.S. Department of Education

CAPTIONING FOR DEAF PEOPLE: AN HISTORICAL OVERVIEW

*Malcolm J. Norwood**

September 1988 marked the 30th anniversary of the first truly successful captioning undertaking for persons who are deaf. Public Law 85-905, which created the Captioned Films for the Deaf Program, was signed by President Dwight D. Eisenhower on September 2, 1958. As a result, deaf Americans once again had access to the motion picture, which became inaccessible with the introduction of sound in 1927. One other extraordinary event also took place that year. This was the broadcast of a rough image of a dollar sign by P.T. Farnsworth.

The sound motion picture, or "talkie," quickly became the true "silent film" for the deaf population, which could no longer completely follow the action. Interestingly enough, it took approximately 30 years to provide deaf persons with a captioned film program, and another 30 years after television became widespread around 1950 to have access to captioned television.

Early efforts to overcome this lack of entertainment were instigated by Emerson Romero, a deaf man, who acquired some sound motion pictures and spliced in the dialogue or explanatory text in the same fashion as the old "silents." Commendable as this effort was, it had no real chance of succeeding due to the lack of adequate funds for acquisition, preparation, and distribution. Nevertheless, Emerson Romero was a true pioneer, and his attempt to overcome this dilemma should never be forgotten.

The next effort, which was more successful and proved to be the forerunner of the current federal program, was the creation of Captioned Films for the Deaf, Inc., in Hartford, Connecticut, by Dr. Edmund B. Boatner, superintendent of the American School for the Deaf, and Dr. Clarence O'Connor, superintendent of the Lexington School for the Deaf. This was made possible by an initial gift of $5,000 from the Junior League of Hartford, which later gave another $2,500. The films circulated by this nonprofit organization were the first truly captioned films, as the captions were etched directly onto the film.

Much credit for the progress made at Hartford goes to J. Pierre Rakow, a deaf man and supervising teacher of the Vocational Department of the American School for the Deaf. An extraordinary person of many skills, Rakow not only learned how to caption films, but pushed, hauled, persuaded, and goaded people in the industry into recognizing the need and their responsibilities to provide an opportunity for deaf people to once again have access to the motion picture.

As with Emerson Romero's efforts, it soon became quite clear that the corporation was too small to adequately meet the needs of deaf Americans. Consequently, Dr. Boatner and others decided to approach the Congress of the United States. Precedent had already been set by the Talking Books Program for the Blind, which had been established in 1933. Why not a similar program--a loan service of captioned films for deaf persons? Thus, in 1958 the cultural, educational, and general welfare of this population was greatly enhanced by the creation of the Captioned Films for the Deaf Program. A part of the United States Office of Education, the program began operation with its first appropriation of $78,000 in 1959, and since then has contributed greatly toward bringing deaf persons into more direct contact with the larger social environment. The Hartford corporation was dissolved and its library of 29 captioned films was donated to the federal government.

*Malcolm J. Norwood, Ph.D., Retired Chief, Media Services/Captioned Films for the Deaf, U.S. Department of Education

Although the initial purpose of the Captioned Films Program was to provide subtitled Hollywood films for deaf people, educators were quick to recognize the potential of captioned films and other visual media as tremendous untapped educational resources. Consequently, the Congress amended the original law several times. The more significant amendments, for the purpose of this article, were Public Law 87-715 (1962), which authorized research, training, production, acquisition, and the distribution of educational media; and Public Law 89-258 (1965), which authorized the distribution of media equipment.

As a result, Captioned Films for the Deaf became involved in designing educational materials to meet the unique learning needs of deaf students. Very briefly, the expanded authority resulted in a number of field services and projects, which included at one time four regional media centers for deaf people, each with a major emphasis. New Mexico State University focused on programmed instruction; the University of Massachusetts on audio-visual technology; the University of Nebraska on film; and the University of Tennessee on instructional television. While these centers no longer exist, they played a major role in the program's development. Currently, there is a nationwide distribution system which includes 58 captioned educational film depositories and an evaluation and selection system to determine which films, educational or theatrical, are added to the program each year.

The program's work with the motion picture industry during the 1960s provided insight into problems that would have to be faced in the captioning of television. For example, it was learned that foreign movies are generally dubbed rather than captioned because many viewers do not like subtitles. It was also learned that decisions in the media industry are based on market statistics. Convincing television networks to caption would require data about the numbers of hearing impaired persons who would watch captioned television programs.

In order to ascertain the acceptability of captioned television to hearing viewers and to obtain data on the potential market, the program contracted for a research study with HRB-Singer, Inc. of State College, Pennsylvania. The most significant finding of the Singer study pertained to the acceptability of captioned programs to hearing viewers. A survey was conducted to monitor responses of hearing viewers to two captioned Disney movies shown with special permission over a cable television station in Centre County, Pennsylvania. The movies were "Big Red," a story about a French Canadian boy and an Irish setter, and "Bear Country," a documentary about North American black bears. The results showed that approximately 70% of the 229 viewers were not bothered by the captions, and it added to some people's enjoyment. Approximately 25% to 30% of the viewers were bothered to some degree by captioning. The survey also showed that while 17% to 29% of those responding indicated that captioning of the more popular programs (news, prime time movies, sports, evening situation comedies, etc.) would bother them, only 10% expressed a negative reaction toward the notion of general captioning. When the respondents were asked what their general reaction would be to captioning only *selected* television programs, 47% said they would react favorably, 43% said they were neutral, and 10% had an unfavorable reaction.

Although program staff were encouraged by the study's degree of positive response to captioning, it was understood that commercial networks are intensely competitive. Staff members believed the networks would not risk losing even a fraction of their hearing viewers. Also, no firm data on the number of hearing impaired persons who would be viewing captioned programs were available. Statistical data varied from approximately two million to 20 million. Program personnel felt the networks would calculate that the 10% who reacted unfavorably to captioned television in the study would be larger than the deaf population. This was based at that time on an estimated hearing television audience of 200 million. It seemed extremely unlikely that the networks could or would compensate for any loss of hearing viewers. This conclusion intensified the determination to pursue various developing forms of technology that would permit captions to be displayed *only* on the screens of hearing impaired viewers whose sets were specially fitted to display captions without interfering with the reception of hearing viewers.

The next major event in the evolution of captioned television was the First National Conference on Television for the Hearing Impaired in December of 1971 at the Southern Regional Media Center for the Deaf located at the University of Tennessee. This conference brought together persons from across the country who were interested in making television accessible to hearing impaired persons. Participants included hearing impaired persons, parents, producers, representatives of federal agencies, and, most significantly, representatives of the major networks.

The conference featured a preview of the open-captioned version of Julia Child's "The French Chef,"

which was captioned by WGBH of Boston under contract with the program. It also included a presentation of two possible technologies for captioning television that would limit captions to specially equipped sets. One system, developed by the HRB-Singer Company, transmitted the captions in a portion of the video signal that was normally received off the edge of the picture. One of the major networks criticized this method of presentation on the grounds that it might intrude on hearing viewers' pictures due to variations in reception and that use of sets to receive captions in this manner might reduce the life of the picture tube. Another system, developed by the National Bureau of Standards (NBS) to carry time and frequency information, transmitted captions in a portion of the video system that was unused in normal transmissions. This portion of the signal is known as the vertical blanking interval. This system was exhibited with the cooperation of ABC Studios in New York with a captioned presentation of the program "Mod Squad."

The conference provided a unique opportunity for informal discussions among deaf persons, representatives of deaf organizations, parents, and television industry representatives. Conference participants concluded that the programs should inform the broadcasting industry of the technological potential for captioned television and should pursue the development of the NBS system of captioning.

During January of 1972, program staff met with a subcommittee of the National Association of Broadcasters to discuss the feasibility of captioned television. This subcommittee studied the issue, and in June of 1972 indicated that this type of captioning was technically feasible, but said certain steps had to be taken before such captioning could become a reality. Basically, the steps were:

- an effective decoder would need to be developed;
- a single system would need to be developed; and
- extensive field tests of the entire system, including receivers equipped with decoders, would be necessary.

In addition, other questions to be answered included:

- the cost-effectiveness of such a system;
- the length of time required to caption a program;
- the cost of captioning a program;
- the cost of equipment to broadcasters; and
- the cost of the decoder.

In order to accomplish these goals, a network had to be involved. Since Public Broadcasting Services (PBS) is quasi-government and because interest in the project was firm, the U.S. Department of Education contracted with PBS to do a feasibility study. It should be mentioned that among the commercial networks, ABC continued to support the project from its inception by providing technical assistance and advice as needed. In brief, closed captioned television resulted from the following milestones:

Fall 1972	A contract was signed with PBS to begin development and testing of two Line 21 concepts--one from NBS and one from Hazeltine Research, Inc. (NBS was ultimately selected.)
Fall 1974	PBS began development of prototype decoders under contract.
Fall 1974	The Federal Communications Commission (FCC) provided temporary authority for an over-the-air test of the Line 21 system using prototype decoders at 12 selected PBS stations nationwide.
Nov. 1975	Testing results led PBS to petition the FCC for permanent authority to broadcast captions on Line 21.
Dec. 1976	The FCC approved permanent petition.
Fall 1977	Under contract, development began on a self-contained adapter and the built-in decoder for home television sets.
Fall 1978	Under contract, development of caption-editing consoles began.
March 1980	Closed captioning officially began on ABC, NBC, and PBS.

There are two things missing from this chronology. These were purposely omitted because some discussion

is necessary. The first of these is the creation of the National Captioning Institute; the second centers on why Sears was the only decoder retailer when decoders were made available in 1980.

During the development of the closed captioned system there were two issues that needed to be resolved: the cost of captioning a program and who would supply the captioning. The cost of captioning had been a point of contention between the networks and the project, and was an issue during the FCC hearings in 1976. PBS had estimated captioning costs at approximately $1,500 per hour while network estimates were much higher. Finally, ABC raised the idea of a nonprofit, free-standing captioning institute to supply captioning for network programs at a low cost. This led to further discussion, which led to certain conditions to ensure participation--one of which was captioning at a rate of no more than $2,000 per hour. Thus was born the concept of a national captioning institute to be located in the Washington area because of the proximity to PBS-trained personnel and equipment. A west coast office in Los Angeles would later be established to handle the needs of program producers concentrated in that area. In the spring of 1979, Joseph Califano, secretary of the Department of Health, Education and Welfare, announced the creation of the National Captioning Institute.

Another issue to be resolved at that time was the manufacture and sale of decoders and television sets with built-in decoding equipment. Following a lengthy exploration of manufacturing and distribution sales which were generally negative, Sears, Roebuck and Company was the only firm consenting to become involved. Sanyo, the company that manufactures television sets for Sears, would produce the decoders in Arkansas and Sears would market them through its catalog. Today, closed captioned decoders are available from a variety of retailers.

At this point it should be noted that while the closed captioned system was being developed, the desire for some captioned TV programming resulted in experimentation with open captions on the PBS television network. Program staff contacted WGBH of Boston. The following resulted:

1971	Funding was provided to open caption Julia Child's "The French Chef" on an experimental basis. The contract was expanded to caption the series.
1971-78	Funds were provided for open captioning of a variety of programs, including the then-popular children's program, "ZOOM."
1973-81	Following an experiment to caption President Richard Nixon's inaugural address in 1973 (which proved the feasibility of taking an event off the air and rebroadcasting it with captions), funds were provided for open captioning of ABC's evening news on the PBS network. Although the captioned rebroadcast was televised approximately five hours later, this was the first time deaf people had access to a current national newscast.

While the federal government provided funds for start-up costs of the National Captioning Institute, it was anticipated that the system would eventually be self-supporting. The implementation of the closed captioning system, with commitments from ABC, NBC, and PBS, seemed to support this contention. However, sixteen hours of closed captioned programming per week and the unstable state of the economy at that time had a profound effect on the sale of decoders, which, after a fast start, slowed down. The result was a "chicken or the egg" situation. Larger decoder sales would mean increases in quality, volume, and variety of closed captioned programs. People were hesitant to purchase decoders because the number of programs was limited. The networks were hesitant to increase their commitments because the number of people with decoders was limited. Increasing one would clearly increase the other. The question was whether to wait for "the other" to happen. To do so would most likely endanger a considerable federal investment as well as the continued existence of the system. It was determined that the major factors for the poor sale of decoders were:

- the depressed state of the economy;
- the lack of a captioned prime time national news program, which hearing impaired persons cited as top priority;
- insufficient numbers of closed captioned programs; and
- an unrealistic expectation by some purchasers that decoder prices would decrease in spite of

the fact that the retailer mark-up was slightly above the actual production cost.

Making use of the statutory authority which allowed support for captioned film activities and other projects that led to the development of captioned television appeared to be the best solution to protect the federal investment and to encourage the purchase of decoders. The program began to issue Requests for Proposals (RFPs) to increase the number of programs available, to assist in reducing the cost of decoding equipment, and to encourage more private sector support. The result has been an exciting blend of public and private support. RFPs were issued for:

- closed captioned prime time movies, specials, and regular program series;
- the manufacture of decoder chips (thus providing a subsidy to assist in reducing costs);
- real-time captioning of national newscasts in prime time;
- closed captioned children's programs;
- closed captioned syndicated programs;
- closed captioned sports programs; and
- closed captioned local news programs with seed funding for up to three years to encourage local community support for permanent captioning.

As early as 1978, the program began to fund developmental work in real-time captioning with the objective of making it possible to caption live programs, i.e., news, sports, the Academy Awards, space shuttle launches, and other live events. This developmental work, however, did not result in the system finally used. The Central Intelligence Agency (CIA) was exploring a system which would allow the spoken word to appear in printed text. As it turned out, a private concern resulted from the CIA project, Stenocomp, which marketed computer translations to court reporters. The Stenocomp system relied on a mainframe computer and was thus too cumbersome. However, when Stenocomp went out of business, a new firm developed--Translation Systems, Inc. (TSI) in Rockville, Maryland. Advances in computer technology made it possible to install the Stenocomp software into a minicomputer. This made it possible for the National Captioning Institute to begin real-time captioning using a modified stenotype machine linked to a computer with a cable.

On October 11, 1982, the first real-time closed captioning took place with the broadcast of ABC's "World News Tonight." Since that time, real-time captioning has been applied to other situations, including classroom experiments at the National Technical Institute for the Deaf, the Supreme Court to allow a deaf attorney to understand the justices and other attorneys, and at numerous local, state, and national meetings of deaf people.

This author has made every effort to cover the overall development of captioning. Because of the magnitude of this effort, it is possible there are some omissions, unintentional as they may be. The major events are included, and it would require a major effort--a book, in fact--to cover everything. This effort has been mainly directed toward television, which perhaps is more appropriate to the conference, Speech to Text: Today and Tomorrow. Obviously, deaf people can still dream of what is yet to come. Tomorrow, if and when the problems (and there are many) are overcome to the point where speech can accurately and conveniently be converted to print, captioned television will be a complete reality, as will the telephone and other communicative devices. It will happen; and when it does, the doors of communication will be opened wider than ever, bringing a new dimension to the lives of hearing impaired people.

Bibliography

Block, M. H. & Okrand, M. (1983). Real-time closed captioned television as an educational tool. (Computer assisted research and instruction for the hearing impaired.) *American Annals of the Deaf, 128* (5).

Boatner, E. B. (1981). Captioned films for the deaf. *American Annals of the Deaf, 126* (5).

Crane, D. (1985). Writing for closed captioned television for the hearing impaired. *IEEE Transactions of Professional Communication*, PC 28 (4).

Norwood, M. J. (1976). Captioned films for the deaf. *Exceptional Children, 43* (3).

Norwood, M. J. (1976). *Comparison of an interpreted and captioned newscast among deaf*

high school graduates and deaf college graduates. Unpublished doctoral dissertation, University of Maryland.

Norwood, M. J. (1980). Just don't scramble the wrong egg. In B. Braverman & B. J. Cronin (Eds.), *Captioning: Shared perspectives*. Rochester, NY: National Technical Institute for the Deaf.

Proceedings of the First National Conference on Television for the Hearing Impaired (1971). Southern Regional Media Center, University of Tennessee.

Root, R. T. (Ed.). (1970). *An analytical and experimental investigation of means of enhancing the value of television as a medium of communication for the hearing impaired*. Study done by HRB-Singer under contract to Media Services and Captioned Films, U.S. Office of Education, 1970.

Schein, J. D. & Delk, M. T. (1974). *The Deaf Population of the United States*, National Association of the Deaf.

QUESTION AND ANSWER

Question: When one is developing a new technology, you can take existing technology and adapt it to a special population or develop a separate technology for a special population. In Switzerland and in Europe, they took one technology and adapted it to various communities. Could you comment on the United States' approach to developing entirely separate technologies for the deaf population?

Answer: *Well, when we first began to develop Line 21, a Teletext system was being developed roughly about the same time. I think Teletext is a wonderful system. No question about that. It doesn't matter to me what system we use. When we selected Line 21 we made use of the system that we had available. For example, I was invited to Australia back in 1981 to help convince the Australian government to support captioning for deaf people. The system in Australia is Teletext. It's not a question of Teletext. The simple fact is that in this country, Teletext never caught on. If we don't have Teletext in this country, how can we provide captioning on Teletext? Teletext was not developed for closed captioning per se. We had to make use of the system we had available to us, and the best way to go at that time was to develop on Line 21. That's the only answer I can give you.*

Question [Charles Estes]: You said that Teletext was developed at the same time Line 21 was but that was the NBC and CBS system, which is a dead format. We know that today the World System Teletext [WST], which European countries use, is a much more dependable format. And we know that there are as many TV sets with World System Teletext built in as there are Line 21 decoders today. And we also know that the EIA [Electronic Industries Association] is supportive of the WST format. Is it feasible to convert the whole system to a WST, or what is the reason for continuing with Line 21 only?

Answer: *Some of you will recall that CBS was pushing for a Teletext system in this country. Captioning is only one small part of Teletext. If you have a complete Teletext system in this country used by all the networks, fine. You can have closed captioning and Teletext. But Teletext did not catch on in this country. Where is it? It's not being used in this country, so what do we have? The alternative is on Line 21. If we had sat back and waited for Teletext to appear, we wouldn't have any closed caption TV today. We would still be sitting here waiting for it. That is the best answer I can give you.*

Comment [Jeff Hutchins]: The World System Teletext cannot provide real-time captioning. At least not in the way we have seen it [during the conference]. It is a limitation of the World System Teletext decoder. Also, it cannot work with home videotape. Even if World System Teletext were adopted by the networks and other program suppliers and even if decoders were readily available, I don't think that in the foreseeable future the system of Teletext is an answer for the needs of the deaf community. I agree with you that Zenith has made many Teletext TV sets available and they are out there right now, but they are not being used to receive captions. Even if World System Teletext took off and was successful, too many services now enjoyed by decoder owners would be lost.

REAL-TIME CAPTIONING: THE CURRENT TECHNOLOGY

*Jeff Hutchins**

As with all successful technologies, the state-of-the-art of real-time captioning has been guided more by the needs of those applying the technology to changing situations than by pure engineering marvel.

The uses to which companies such as American Data Captioning have put real-time captioning have established the goals to which the engineers must aspire. Basically, our demands for improved systems have fallen into three categories:

- more economical machines;
- faster machines; and
- more accurate machines.

This paper details the ways in which these improvements have occurred and the steps yet to be taken.

Basic Concepts

Real-time captioning refers specifically to the simultaneous creation and transmission of captions for display purposes. In most cases, real-time captioning occurs during live, unscripted, or partially scripted events--television programs, classroom presentations, courtroom trials, panel discussions, hearings, meetings, and the like.

Those in the captioning business would gladly use any system or technique that would help convert speech to text in the fastest and most accurate way. For the past decade, the method that has worked best has been computerized translation of stenotype "strokes" into English.

Stenotype is the system of shorthand notation used by, and most frequently associated with, court reporters. Court reporters must transcribe precisely the proceedings in a courtroom at rates up to 300 words per minute. (Except on rare occasions involving deaf participants in the court, court reporters are not required both to transcribe and translate the proceedings. They record the dialogue in real time, then later translate the shorthand into readable English, correcting any inaccuracies before delivering a written transcript.)

Unlike conventional typing strokes, each shorthand stroke can represent many letters, sounds, or even complete words and phrases. The stenotype keyboard, with 23 keys, is not based on characters--such as "A", "7", or "$"--but on sound combinations called "phonemes" and on shorthand substitutions. The shorthand machine allows the stenotypist to press multiple keys at the same time, thus providing thousands of unique combinations, each of which can equate to different words or parts of words.

Stenotypists can easily look at the notes of their transcriptions--which, to the average person, resemble some unpronounceable foreign language--and read them. For a machine to read the transcription and determine its English equivalent is far more difficult, especially in real time. The key to successful and accurate computerized translation is the look-up "dictionary" employed by the system. A dictionary is a table of steno entries and their English equivalents. All stenotype translation systems use one or more dictionaries. Since every stenotypist has a unique style and special entries for certain words and phrases, no one dictionary can serve all users. Each user must create and constantly adjust his or her own personal dictionary.

*Jeff Hutchins, Vice President, American Data Captioning, 312 Boulevard of Allies, Suite 200, Pittsburgh, PA 15222

A stenotype reporter is trained to listen carefully and to break words into phonetic components, while considering the context in which the word is spoken, so that the reporter can distinguish word boundaries and differentiate between homonyms such as "there/their/they're." These concerns are not critical for the court reporter who has the opportunity to review his or her work before sharing it, but in a real-time environment, such concerns are of tremendous importance. Unexpected names and unusual words also pose a hazard in real-time reporting. The care with which reporters prepare their dictionaries can eliminate many problems.

The real-time reporter minimizes errors by anticipating for the job at hand. Researching the topic(s) of discussion is the primary step. Common words remain in a permanent dictionary and rarely need attention, but proper names and special terms, such as technical jargon, are generally put in temporary dictionaries to be used only on specific jobs.

Technical Development

The first real-time system, designed by Teledyne Geotech, used a large mainframe computer to perform the translation of stenotype strokes. The computer was expensive, not portable, slow to translate, and required a great deal of effort to prepare a personal or special job dictionary. It was clear from that first effort that several magnitudes of improvement would be needed before real-time translation was ready to go "on line."

The breakthrough to the first usable system came when the National Captioning Institute contracted with the now-defunct Translation Systems, Inc. (TSI) of Rockville, Maryland, to convert TSI's off-line computerized translation system into one which could accept steno machine input during translation. That machine, dubbed "InstaText," was first used on the air in 1982.

InstaText was revolutionary in several ways. First, it used a mini-computer--the Jacquard J-500--which could be located in the same room as the user. It employed a removable hard disk (replaced two years later by a high-capacity Winchester-style hard disk). This feature made it possible for several reporters to share the same system with no more than a few minutes needed to swap dictionaries, which were housed on the hard disks. InstaText's "throughput"--the amount of time from the reporter's stroke to the English caption's output--averaged between four and seven seconds, depending on the speed of the speaker, but was deemed acceptable.

This lag time, as it is most commonly called, resulted from several factors. First, the reporter, in listening to the speaker, would generally pause between one half and two seconds before making an entry. This pause allowed the reporter to hear the entire word or phrase correctly and determine if any special entries were needed to facilitate accurate translation. Second, the computer had to collect, or "buffer," enough strokes to allow it to make an accurate translation. Since some entries required as many as five strokes (and few required less than two) no translation would begin until either eight strokes had been entered or until the reporter hit a special key to force the translation of all strokes in the buffer. Finally, the computer spent a fraction of a second accessing the disk and looking up the English translation of the strokes.

InstaText's most pronounced weakness was its lack of software to help reporters update their dictionaries. Editing was done using a routine word processor, which was slow and clumsy by today's standards and which offered no function keys or other tools specific to the reporter's needs. For example, reporters could not just input entries directly from the stenotype machine; and, from the disk file created during a real-time session, reporters could not automatically select and incorporate into the dictionary those strokes which had failed to translate. Although this weakness did not inherently affect InstaText's accuracy of translation, in practice it was a hindrance, especially for shows which needed last-minute dictionary preparation.

Another distinct disadvantage of InstaText was the price of the hardware. While much less expensive than the mainframe computers, a new J-500 cost about $15,000, and the hard disk drive needed for dictionaries added many thousands more. Repairs were also costly. A replacement CPU board for the J-500 cost at least $5,000.

For several years after its introduction, TSI's InstaText was the only real-time steno translator on the market, for captioning or other purposes. But other companies that marketed systems to the shorthand reporting industry were busy developing more advanced computerized translation systems, and two of those companies became interested in the challenges of real-time data entry and translation.

Jerry Leffler, a California shorthand reporter, became interested in creating a new theory of shorthand, and, with several others, developed a translation system which adopted the name of his theory--Digitext. This system relied on the same keyboard as the well-worn stenotype theory, but revised the way in which words are formed. Digitext--

the system, not the theory--was developed on a more modern computer than was used by the original InstaText, and improved on the performance of the older system. For example, Digitext's lag time typically ran no more than four seconds, and the need for job dictionary preparation was much reduced. The hardware was more compact and less expensive than TSI's system. Digitext had the look of a winner.

But today, about four years after Digitext's introduction, the only captioning company using it is Leffler's own Captioning Concepts, Inc. The reason has more to do with the shorthand industry than any particular weakness in the Digitext system or theory. Schools still teach standard stenotype as the prevailing theory for shorthand reporters, and cross-training a stenotypist to use Digitext theory has proved to be difficult and time-consuming.

About the same time that Digitext first appeared, another California company--Xscribe--decided to add a real-time capability to its successful steno translation system. Like Digitext, Xscribe's system works only on a customized microcomputer made in its own factory, and it also improves greatly on the performance of the original InstaText system. Xscribe lag times average between two and three seconds. Unlike Digitext, however, the Xscribe Captioning System, as it is known, relies on standard stenotype theory for its input, making it more quickly compatible with the writing styles of most working reporters.

TSI, meanwhile, was running into financial difficulties and ended up declaring bankruptcy, throwing the future of InstaText into grave doubt. When the Maryland courts divided TSI's assets, a newly formed company called Advanced Technology Concepts (ATC) bought up the rights to TSI software, including InstaText, and began work on a PC-based version of the system. By using new translation algorithms and faster microprocessors, ATC made the new InstaText vastly outperform the original while retaining certain unique features. In 1988, Stenograph Corporation, one of the oldest companies servicing the shorthand reporting industry, acquired InstaText and now sells the system under its name.

Current Status of Technology

So today there are three viable real-time captioning systems for sale. Each system's marketers regularly release software upgrades which add new features and improved performance. Many of the features enhance the user's ability to create and update dictionaries, thus improving the accuracy of translation.

Each system has its proponents: American Data Captioning served as a Beta test site for the Xscribe Captioning System and today uses the system with great success for all its real-time captioning. The National Captioning Institute has recently bought the Xscribe system and is in the process of converting to its exclusive use for real-time. The WGBH Caption Center chose to go with the new InstaText system, also with good results, while Captioning Concepts, Inc. continues to employ Digitext. Among users other than professional captioning companies, Gallaudet University and the National Technical Institute for the Deaf use Xscribe.

Pros and Cons

Users can spend hours extolling the unique features and strong points of their chosen systems. There are, of course, price differences although these seem to be trivial in the long run since the manufacturers are attempting to be competitive in the very narrow captioning marketplace. There are also obvious hardware differences, the importance of which vary with who analyzes them. The WGBH Caption Center, for instance, has expressed a strong preference for using a system which can operate on standard off-the-shelf computers. Users of Digitext and Xscribe systems have not found using custom hardware to be a problem.

It is clear that all three systems are only as good as the skill and the degree of effort put forth by the users. In the proper hands, each system is capable of producing highly accurate captions with minimal lag times. Each provides its users with tools which can optimize their efficiency and shorten the time they must spend preparing for each new real-time program. Each system also comes with utilities for handling prescripted captions.

Those persons contemplating the acquisition of their first real-time system will find that no easy decision awaits them, and that no one system is clearly ahead of the others. The choice will boil down to personal preference for hardware, perceived availability of reporters for the chosen system, and the deal they are able to make with the sales representative.

Future Development

What does the future hold for real-time captioning? Systems based on using shorthand technology will continue to make modest improvements in their hardware and software, progress which will be significant to those of us who must use these systems

daily and who wish to lower our operational costs through less expensive equipment and less time-consuming preparations. But these improvements will have no major impact on the end product--the captions viewed by the audience. The simple fact is that the systems cannot become much better; they can only become cheaper and more reliable.

It is almost blasphemous in this high-tech age to suggest that a technology like that now used for real-time captioning--a technology based on such low-tech tools as a decades-old shorthand machine, a simple (by today's standards) microcomputer, and a human being manually entering data--cannot become better. But the shorthand-translation-based systems have left themselves little room for improvement. Professional users regularly achieve 99% or higher accuracy rates, meaning that they are making approximately one error in every 100 words typed. Lag times cannot, as a general rule, drop below two seconds because no accurate translation can occur until some data beyond the current word have been received. Even if some genius manages to cut the lag time by 25%, the home audience is not likely to notice the one-half second improvement that results.

If there is a weak link in today's real-time captioning method, it is the human one. The use of people instead of machines to input the sounds and words to the captioning computer does not, as some people have believed, hurt the accuracy or lag times of captioning. To the contrary, the human factor almost certainly enhances those two measures of captioning quality because of the human's infinite ability to adapt and be flexible. But people weaken the chain because they are fallible--they have bad days; they get sick or take vacations or resign, leaving the captioning company to spend weeks or months preparing replacements; and they demand to be paid.

The next generation of real-time systems used by captioning companies will be strictly machine-based, employing speech recognition techniques. But, given the high degree of accuracy and short lag times enjoyed today, it is likely to be well into the next century before speech recognition systems are economically or qualitatively a viable alternative.

REAL-TIME CAPTIONING: TRAINING AND EMPLOYMENT

*William Oliver**

Capturing speech as it is uttered so spoken words can be read in printed form is a skill that can be traced to the fourth century B.C. Manuscripts of the Egyptians and Greeks displayed "shorthand notes" in the manuscript margins. Marcus Tullius Tiro of ancient Rome developed a system by which he could record speeches of the orator Cicero. The purpose was to preserve history and, equally important, to have a printed document for general reading or future study. As the years passed, different systems of "shorthand" were developed and used specifically in legal settings. Recorded speech has been used extensively from the Roman senate to the modern day courtroom.

The "reporter" who has performed this service through the years is a professional in much demand, demonstrating great skill and knowledge. During the past fifteen years, the shorthand reporter has continued to develop academically. The skill of capturing speech has merged with computer technology to produce the greatest proficiency available in our space age. One of the technological advantages of computerized reporting is the advent of captioning. Other advantages have been demonstrated in the courtroom of the future. In that legal setting, courtroom testimony is presented to hearing impaired individuals immediately. Additional technological advantages are available.

While the reporter has been a highly educated individual, academic requirements continue to grow. Computer technology demands that reporters increase their educational development and knowledge. As a professional, the reporter interacts with all professions. The reporter is required to have knowledge in such areas as law, communications, technology, finance, medicine, engineering, government, manufacturing, transportation, and business. As reporters move into more technical areas, they become more specialized. The area of captioning is a highly specialized and technical area. The captioning reporter has a whole new area of specialized education that must be mastered.

Even though there is no formally designated educational process for captioning reporters, they must have advanced training, which usually is attained through an internship. To become a reporter, one must attend college for two to four years. The reporter becomes either degreed or certified after completing formal training. A reporting student must develop excellent English and grammar skills. Additionally, a reporter must learn to write on the stenograph machine at a minimum rate of 225 words per minute. Upon reaching such speeds, a reporter is then striking the keyboard of the stenograph machine four to six times each second, with great accuracy.

The stenograph machine has 22 keys and a number bar. By touching one or more keys, the reporter captures all words spoken. The spoken words are written on the machine in a sort of code that is phonetically based. The stenograph machine has the technical ability to interface with a computer that will eventually translate the code into printed English. The computer contains a dictionary of English words. The average has between 70,000 and 100,000 words. The stenographic "code" is entered into the computer, which searches the dictionary for the English word that matches the code and then prints the English word. When a reporter is captioning a live television program or a live public presentation, he or she connects the stenograph machine directly to the computer. As the reporter is writing, the code goes instantaneously into the computer, which finds the English match for the code and displays the English word on the television or display screen. This process takes about two

*William Oliver, Ph.D., Immediate Past President, National Shorthand Reporters Association, Stenograph Institute of Arkansas, 350 Union Station Square, Little Rock, AR 72201

seconds from the time the word is actually spoken.

This technology is identical to the way the courtroom of the future functions, displaying the actual testimony as it is occurring. An additional feature the courtroom offers is an instant printed copy of everything as it appears on the screen during the proceeding. There are unlimited possibilities where this technology can be used to assist the deaf community: the classroom, public conventions, church services, courtrooms, television, legal meetings, or just about any place speech is used for communication.

As a professional court reporter who has a strong involvement with the deaf community, it is with much professional and personal pride that I present our enthusiasm for this technology. The National Shorthand Reporters Association pledges its support in the continued input concerning the development of this type of technology. We further pledge continued involvement in training and training methods for real-time captioning. Much of our involvement focuses on the legal system, which is understandable since that is our natural professional environment. We are proud to have played a major role in literally breaking the legal sound barrier in both federal and state courts.

QUESTION AND ANSWER

Jeff Hutchins
American Data Captioning, Inc.
and
William Oliver
National Shorthand Reporters Association

Question: I found it interesting that captioning technology can be used to help a deaf student integrate into regular classes. How is that being funded?

Answer [Bill Oliver]: *In our particular instance, the organization that I am associated with, EDUCORP, Inc., has two schools in Texas and one in Arkansas. We are doing part of the funding, the University of Arkansas is giving us advice and counsel, and the school for the deaf is furnishing the students. At this point, it is costing no one, except our school, anything. If you are interested, I would like to get that information so the National Shorthand Reporters Association can decide which projects would be its priority.*

Question: Do you see this coming to the universities in the near future?

Answer [Bill Oliver]: *Yes, I do. It's difficult to get the universities to believe that it needs to be there, but I think by doing these tests we will be able to show that it is occurring. I talked with a woman in Kansas City, Missouri, yesterday. A freshman in one of the universities there had been introduced to captioning in his senior year of high school. He took that concept to the university, and the university literally worked his schedule around the schedule of the captionist. There is a captionist who follows that one individual to every classroom, and it is my understanding that this has been very successful in the short period of time that it has been working.*

Question: What is the hourly cost for this?

Answer [Jeff Hutchins]: *If your question is what is the cost per hour to real-time caption, then it does vary from company to company, and situation to situation. For example, a company that is captioning the same program every day of the week all year long can obviously do so more cheaply than a company which has to go to one location, set up, bring in a staff, caption there, then pack it all up and go somewhere else. Captioning conferences like this is actually more expensive now, using today's technologies, than an everyday kind of captioning. The costs range anywhere from a few hundred dollars an hour to maybe a couple of thousand dollars an hour to do real-time captioning.*

Answer [Bill Oliver]: *I would like to say one more thing. This is a good place for our graduates to do their internship. Depending on what we find, this may be very successful. If it is successful, it would certainly affect the cost that a college or university would be paying. Right now, it's my understanding that the captioner for the University of Missouri student is being paid $15 an hour. That's a totally different concept from what Jeff just talked about. But I believe it is something that we could merge into the captioning community.*

Question [Judy Tingley]: We talked about the cost of captioning. In a classroom in a university, is it possible to centrally locate the equipment and the stenographers in one location, and then pipe in the lecture to that location, and then pipe back the captioning, to save the cost of moving the equipment around?

Answer [Jeff Hutchins]: *Technically, it's possible to do that. Ross Stuckless is very well aware of efforts to achieve that at NTID [National Technical Institute for the Deaf]; you have to be aware that if you have maybe 50 or 60 different classrooms in operation on a campus at one time, the cost of routing the video and having a camera wherever you might need it would be very high indeed. It would depend on the size of the campus and the composition of the students as to whether that was a cost-effective thing to do. At a campus like Gallaudet or NTID where all or most of the students are deaf, that might work out. I would guess in a campus situation like at the University of Missouri, it might not be cost-effective because the miles of cable that would have to be run or the microwave systems that would have to be set up to transmit video from the classroom to a central location would be prohibitively expensive.*

Question [Judi Bauer]: I am from the Canadian Hearing Society. In Canada, we have Insta Cap, which uses a regular computer keyboard for putting captions up, so any skilled secretary can use it. Obviously, it is not the same as this system. You can't get everything but you can get quite a lot with a skilled secretary, and it brings the cost down significantly because you are talking about a clerical person. For classrooms, small conferences, even in board meetings, is this kind of technology being developed in the United States? Can you comment on the utility of it for situations where we couldn't possibly afford the type of equipment you have here?

Answer [Jeff Hutchins]: *Yes, I think it is. I have seen basement built-type systems that do this type of thing. In fact, the very first real-time captioning that was done in the world was done in England, and not in the United States. It was done on the type of system you just described. I believe it was for the royal wedding of Prince Charles and Princess Diana, and it was dreadful in the words of most [people] who watched it. They really felt like they were being left out. Normally the typist was a good typist, but they had problems. The point is that there are systems. I understand what you are saying. There are certainly situations where something is better than nothing.*

I think that for certain situations, the kinds of situations my company is involved in captioning, we must have the kind of technology we have here. On the other hand, where I would hope the technology would go in 15 or 20 years would be to the kind of system you described--using a good typist, producing perhaps 50% of a transcript accurately. Certainly, I would think in the next 20 years we will find that automatic computer systems will be able to do at least that well. Getting only 50% for broadcast captioning and news captioning would be just awful, but perhaps in some situations 50% would be quite acceptable.

Question: Could you explain a bit about the process the stenographer uses in building her dictionary?

Answer [Bill Oliver]: *I'm not a computer expert by any means, but stenographers usually do it the way I built my dictionary. I wrote the words the way that they're created on the stenotype machine. I sent that to the stenograph company after I did this big list of words, and they sent me back a dictionary. It is a joy to be able to add words as I go along. There are some that put in the stenotype word and the English word. Some of the computer companies build their dictionaries just as they go along, putting in the stenotype and English words, creating the dictionary they need.*

Question: I wonder if a future decoder could possibly have both Teletext and Line 21 installed so we can have both?

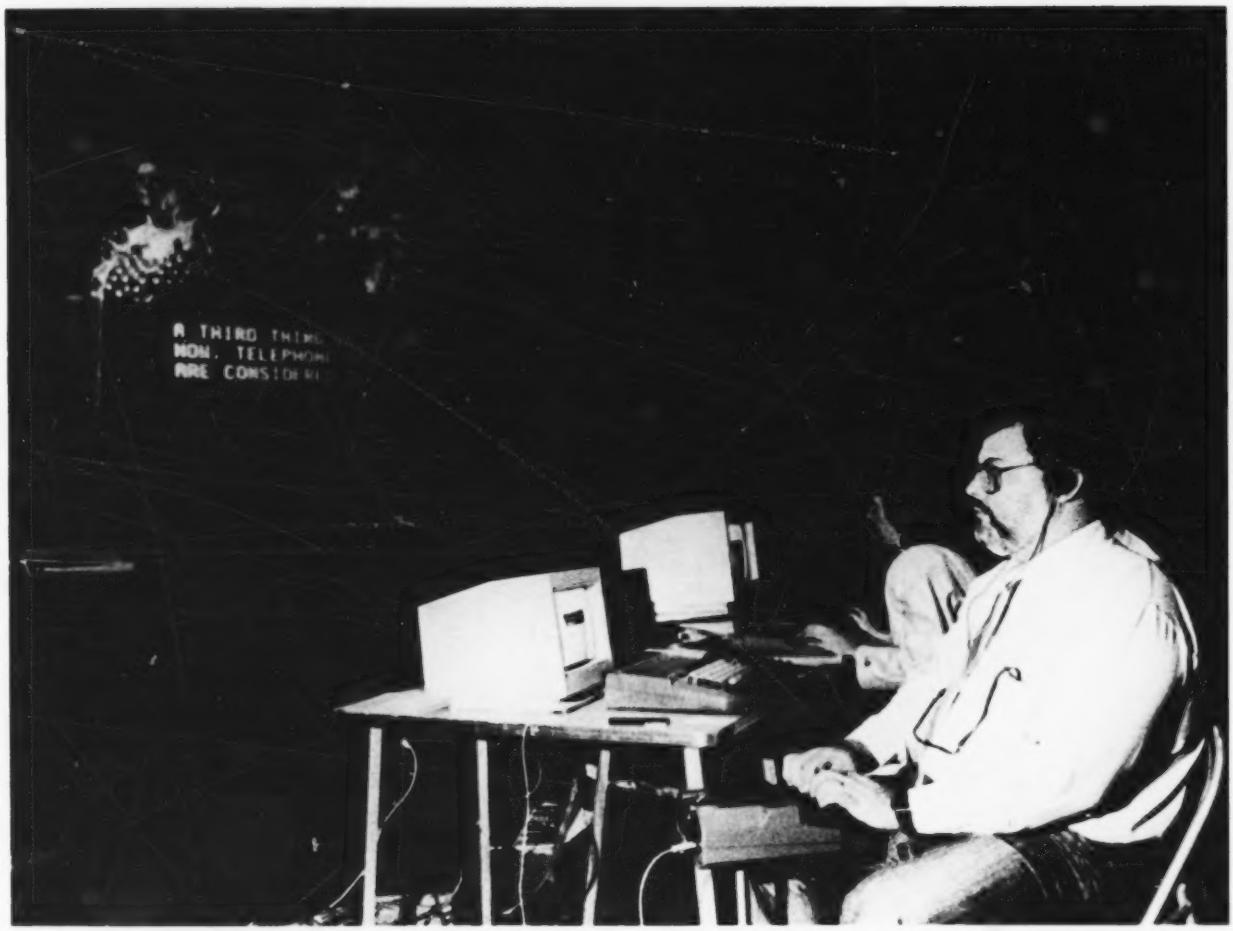
Answer [Jeff Hutchins]: *I have worked with TDI [Telecommunications for the Deaf] to establish a task force on captioning to promote exactly these kinds of issues. Charles [Estes] in the audience is the chair of the task force, and I am chairman of the technical subcommittee of the task force. That certainly is an issue. It came up [at the National Conference of Deaf and Hard of Hearing People] in El Paso. Zenith, the only company that is producing decoders in a Teletext format and making them readily available, says they have no plans to incorporate a Line 21 decoding capability. The TDI task force will probably adopt a resolution, but it's early and we haven't had a chance to study it or take a position. I believe the position of the task force is going to be that we would like to see Teletext decoders automatically decode captions regardless of the format in which they were encoded. I mean that if the captions were on Line 21, the Teletext decoder would find them and decode them. Or if the captions were in Teletext, the decoder would show them, too.*

The consumer should not have to know anything about the different technologies by which captions are delivered. It's not fair to ask the consumer to know that much about how these technologies work. Hearing people are not required to know that much

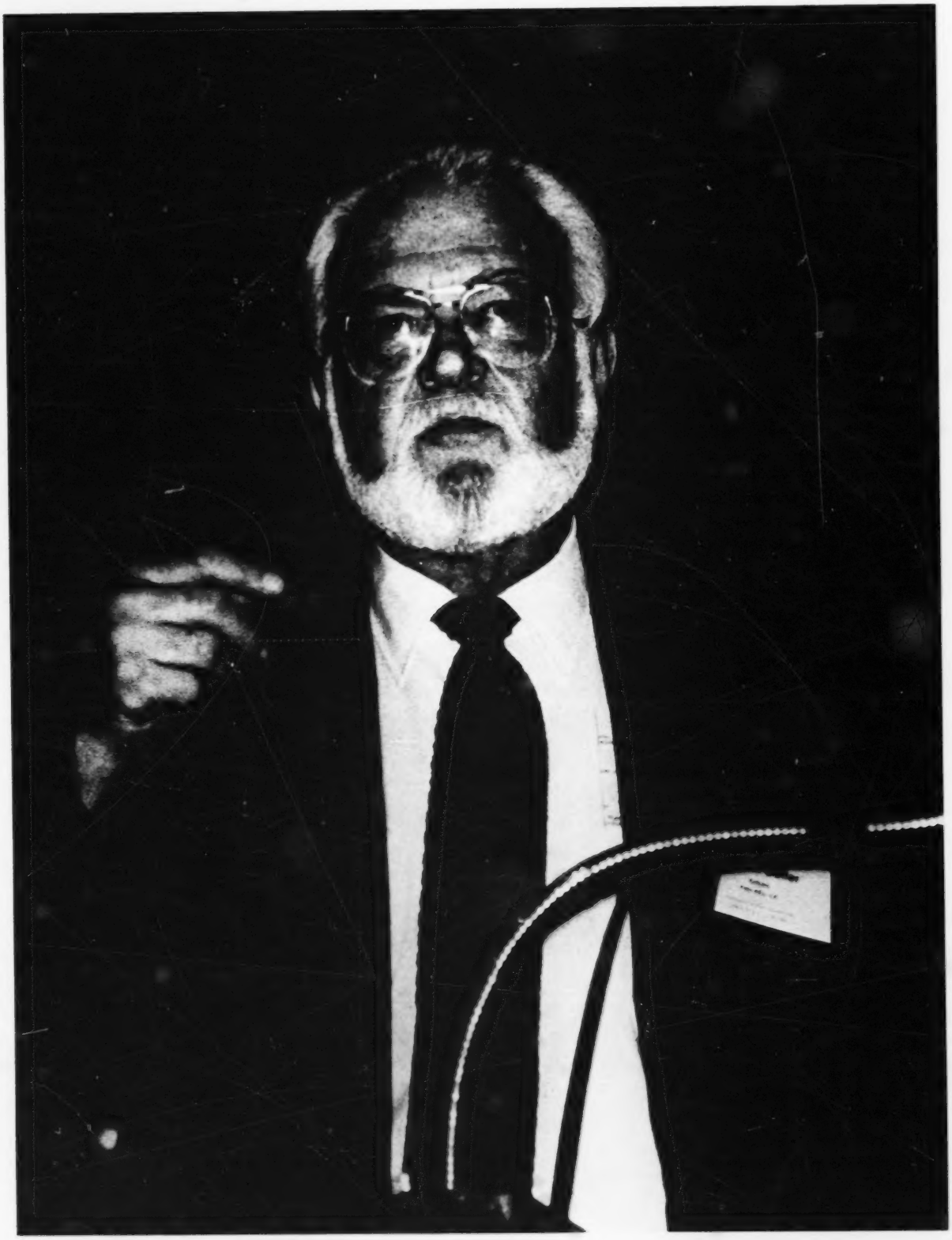
about any of the technologies used to deliver services to them. When deaf people walk into an appliance store ten years from now, we don't expect them to know that NBC broadcasts this kind of Teletext and the captions are on Line 21 and CBS does something different and only this decoder will work with CBS and this one works with home video. You don't want to know that and you shouldn't have to. The task force is going to address those issues. If you have ideas or know someone who has ideas about these issues, I would recommend that you send them to TDI–address them to Charles Estes–and let TDI know your feelings.

Question [Bill Cutler]: I have been impressed with the number of people whose faces took on a look of panic when the captions failed for mechanical reasons. Jeff, can you give me the incremental costs of adding the photo image, as compared to pure captions? Is it 10% or 25%? In other words, if you had been presenting nothing but captions as compared to the full screen with the video image.

Answer [Jeff Hutchins]: *Of course, we could have gotten something smaller and cheaper but the rental of this size screen and projector was about $2,000 for the week.*



Real-time captioning of a speaker's presentation.



William Cutler, Self Help for Hard of Hearing People, Inc.

CAPTIONING AS AN INTERPRETIVE MEDIUM

*William Cutler**

Some people probably think I talk too much about assistive listening devices (ALDs). But I don't apologize for it because I feel very strongly that we should use every available means to cope with our hearing loss. Of course, depending on an individual's hearing characteristics, assistance "beyond the hearing aid" may not be critical. Those with a mild or moderate loss do not require as much help. But some of us with a severe and profound loss need it badly. For instance, because of my poor discrimination, my electronic amplifying gear provides only about 20% of my understanding; lipreading (under good conditions) might add 30 to 40%; but I have to guess at what I think I heard for the remaining 40%.

It is that last, very imperfect part of my understanding that drives me--and those trying to communicate with me--crazy. So, I always welcome yet another ALD. More specifically, I mean any medium that uses my eyes to assist my ears. Advocates of sign language and cued speech point out that they are excellent assistive understanding devices, and some hard of hearing individuals have been sufficiently motivated to learn to use these language assists. Many more of us are able to utilize existing--or even newly acquired--typing skills plus our eyes for the printed words of TDD phone calls, especially with the advent of more relay services. And certainly, those who are not taking advantage of closed captioned television and video are missing a very valuable eye-assisted "listening" device. Even my hearing wife enjoys the PBS "Mystery" series far more when she can *read* some of those strange British accents.

Most of us have enjoyed the benefit of assistive listening systems (ALS) in various public venues. Audio loops at most SHHH chapter meetings, FM systems in churches, and infrared in some theaters and auditoriums are helpful--but only partially, for people like me. So I'm always delighted when these are supplemented with visual assistance, such as slides or other illustrations by the speaker, or a note-taker's abstracts on an overhead screen. The SHHH convention in Rochester offered these to varying degrees of satisfaction. At the International Federation of the Hard of Hearing (IFHOH) Congress in Switzerland on July 11, 1988, all papers were verbally interpreted into English, French, and German. But more valuable, considering the difficulty of hearing and lipreading an accent, the papers were projected on a screen (again in all three languages) during each presentation. It improved everyone's understanding.

Perhaps I am stretching the definition of captioning by referring to the simple overhead projection of a script although it is one of the earliest assistive listening systems using the eyes. And it is available now, on a real-time basis for about the same hourly cost as a sign interpreter (if not by a lay volunteer). Its constraint is that the speaker must closely follow his or her paper. The next step, closer to real-time captioning, is the Kodak overhead projector integrated with a personal computer, permitting typing of the notes with instantaneous projection. With a good, fast typist on the console, the readability of the notes is dramatically improved.

Some people might not accept my next example as either captioning or interpreting, but it fits my definition of both. Further, I consider it a basic communication access which could be available as soon as society sets a high enough priority. Several technologies already exist for screening of transportation information, both routine and

*William Cutler, President, Self Help for Hard of Hearing People, 2590 Marshall Drive, Palo Alto, CA 94303

emergency. While a TV monitor would serve nicely (as it does for the listing of flights in terminals) for static, detailed information, a more important service would be large type translation of announcements, probably as a flowing array, wherever they occur on ceiling speakers, including the transportation vehicle. However, I must confess some pessimism about the prospects. After a year of promotion, we finally persuaded management of the Bay Area Rapid Transit system in the Bay Area to do an engineering study, only to have the concept rejected when a cost estimate of $3 million was submitted.

Another recent development will, in my opinion, become a popular caption interpreter. Ultratec has announced a large visual display for its TDD, which, I think, will prove more popular as an interpreting device than as its intended use for deaf-blind individuals. Connected to the TDD printer port, it is a foot-long, free-standing, movable screen with 20 flowing characters ten times larger than those on the standard TDD. I envisage it facing the hearing impaired person at a reception counter and serving far better than shouting or scribbled notes. Or, picture it in front of several hard of hearing people at a conference table or in lecture seating. The under $1,000 cost (TDD and ancillary display) is less than other captioning hardware, and an alert, skilled typist will be able to provide meaningful abstracts of a discussion. We hope to try it for committee meetings of the newly reorganized California Telecommunication for the Deaf and Disabled Program, with professional note-takers funded by the program as are sign interpreters.

Both the SHHH and IFHOH meetings also provided another useful visual medium by projecting on a large screen, viewable from anywhere in the hall, a TV close-up of the speaker. This facilitated speechreading, which otherwise would not have been possible except for those in the front row. I found, by the way, that some cameramen insisted on the traditional (admittedly more photogenic) upper torso view, at the expense of a bigger picture of the face. (In this context, I am more interested in lips and eyes than I am in neckties and bosoms.)

At the SHHH convention in Rochester we had the ultimate visual assistance of real-time captioning (such as we enjoyed at this conference) provided by the National Technical Institute for the Deaf (NTID), which developed the system for classroom use. Just as in broadcast TV captioning, the speaker's words appeared on the screen below his or her projected face. I must admit that the commendably brief delay of real-time captioning (the time it takes a stenotypist to enter his or her shorthand, and the computer to translate it into English using its sophisticated dictionary) is sometimes annoying. If I can lipread the speaker, I ignore the captions. But they are always there for me to check on something I don't quite comprehend.

Real-time captioning on all three networks makes it possible for me to make sense out of the national evening news. No longer do I have to ask my wife (after a "voice-over" segment when the announcer's face wasn't available to lipread), "What was that all about?" The service is being expanded with the captioning of local news in about 20 metropolitan areas. One development which is accelerating this movement is called "script captioning" in which special, affordable ware converts the usual teleprompter script into a closed caption broadcast signal. The captioning therefore becomes a byproduct of another necessary activity, rather than requiring a special, expensive stenographer and computer system. Of course, the captions do not cover spontaneous remarks, but the important facts become available to our assistive listening eyes.

Another byproduct may, in the not-too-distant future, provide a critical interpreting service through real-time captioning. One of the most serious deficiencies in communication access occurs in courtrooms across the land, depriving hearing impaired defendants, plaintiffs, attorneys, jury members, and judges equity in the justice system. A growing number (half in California) of court reporters are using real-time hardware and techniques for computer-aided transcription (CAT) in place of the traditional, laborious, time-consuming transcription of their stenotype tapes. They find the initial $20,000 cost of the special computer and software a good long-term investment in terms of the expense and time for manual transcription, not to mention faster service on requested copies. The good news is that this same computer can feed, once more as a byproduct, closed captions to courtroom TV screens wherever needed. A little delayed, and not letter perfect (as we have observed in broadcasts), the captions provide an adequate, meaningful, and legally accepted translation of what has been said.

But notice that superior interpreting--whether sign language or some form of real-time captioning--still requires expensive human skills, effectively denying their being commonly available. That is why I have emphasized those approaches which provide captioning as a byproduct. In suggesting that, even though imperfect, they are better than nothing, I may be in conflict with those who are concerned that

imperfections discourage acceptance. But I don't think that will be true for the millions of us who need any kind of help we can get.

Ultimately, there will be speech-directly-to-print devices. But it is one of the most challenging goals in science, and those who have worked on it for a decade expect it might require another fifteen years to develop a viable product. I must confess little optimism for the recently announced $100,000 competition for a hand-held speech-to-text transcriber design, although I would love such a miracle. *[Editors' Note: This refers to a competition to develop a hand-held speech recognizing device for communication between hearing and deaf people. The competition was sponsored by the Executive Audial Rehabilitation Society of Corpus Christi, Texas.]* In the meantime, real-time captioning serves well--where it can be afforded (a competent captioning stenographer earns up to $50 an hour). It can be used by everyone who can read; no special language skills are required. This is a major advantage over sign interpreters with an equivalent labor cost (about $50 an hour for a two-person team) who are of value to only one-quarter of those with a severe or profound hearing loss.

For those of us who don't hear well, "the EYES have it!"

QUESTION AND ANSWER

Question [Jeff Hutchins]: When we talk about "50% being good enough," do we mean 50% of the volume or 50% of the accuracy? There is a difference. The difference is this: We can caption accurately 50% of everything that is said or we can caption 100% of everything that is said with 50% accuracy. When you say that 50% is acceptable to you, are you talking about 50% accuracy or are you talking about just accepting 50% of what is said?

Answer: *I guess I had been talking about a mix. In the case of local news script captioning, I'm talking about the volume. I'm being denied the spontaneous remarks in weather and sports. I am getting accuracy because it is a script that has been written. I am getting 100% accuracy with 80% of the volume that is coming on the air. In the case of (we haven't come up with a name for it) large print interpreting, you are missing some of the volume because the typist has had to abstract, we hope intelligently. We may have some typos. Incidentally, I will be happy to accept less than that 80% accuracy. Many people who have a hearing impairment are hearing garbage all the time. You are used to extrapolating and interpreting in between that stuff that is going around in your head. It is nothing new for me to try to figure out what is really meant. It is nothing new for me to fill in the lines of what is being typed on that 50% volume device. That's not a very specific answer, except that I will take anything I can get. I will even take 30% because that's better than nothing. Obviously, the more volume and the more accuracy, the easier it is. I don't want to feel shot at the end of the day from trying to understand what I heard, but I am willing to feel sort of shot and require only one martini instead of three if I have some help from captions.*

Question [Charles Haines]: I am interested in the 50% question but I have another one. Opera performances now have subtitles over the arch of the stage. We heard this morning that some hearing people, I think entirely unreasonably, object to captioning on the bottom of films. Is there any activity that people here know of to put subtitles not only over opera but over performances of live theater, and perhaps over films? Can the use of subtitling spread? Who is in charge of it, what is the future, or what are the possibilities of subtitles?

Answer: *I certainly don't have an answer to that. I should have mentioned it is a worthwhile text device, except that it is not spontaneous. It is not real-time. They have worked hard to come up with that relatively minimal text describing what is happening on stage. I am not aware of anything involving theater. It may be because they ad-lib too much, but I don't have that answer. I don't know whether anyone in the audience would have it.*

Question [Nancy Connors]: You were mentioning what your priorities are with technology, perhaps what many would call low-tech over high-tech. Now, a lot of technology results from research funds. Would you advocate having hearing impaired and hard of hearing people more involved in the process that distributes research monies so that the technology suits the consumer?

Answer: *I certainly would agree that using disabled people on review panels would be appropriate for grants involving disabilities. Of course, Mac Norwood, who gave away a lot of grants when he was at the Department of Education, might answer that better than me. Whether or not and to what extent*

they used disabled advisors in the process, I don't know. I do know that many of the grants of which I am aware include disabled people–consumers, if you will–in the results. I mentioned that I was involved in one of Judy Harkins' projects a couple of years ago in which she was contacting disabled hearing impaired people around the country to obtain input which she would then transfer to the manufacturers. Certainly I would agree that disabled people should participate in the process. When I was in education, a review committee of peers was typically involved in the preliminary decisions involving a grant award. I have been out of that racket for ten years and I don't know if it is still the pattern or not.

REAL-TIME CAPTIONING IN EDUCATION

*A presentation by E. Ross Stuckless**

During the late 1960s and early to mid-1970s, a number of research investigators examined the relative amount of verbal information--the kind of information that is transmitted through language of one kind or another--that deaf children and adults are able to receive and process visually through print, speechreading, signs, and fingerspelling. The general weight of these studies supports print.

To me, the most satisfactory explanation for this observation rests in the fact that, unlike the other receptive language modes, print has a unique spatial quality which makes it amenable to processing through the eye and its associated neural network. The other language modes have in common a temporal-sequential "on again, off again" quality more amenable to auditory than visual processing.

Considering the dependence of deaf students on their vision for the intake of verbal information and the compatibility of print for visual processing, it is reasonable to ask why print is not used with greater frequency for communicating with deaf students in the educational setting. I believe there are two answers to this question. One answer is to say, "It is." That is to say, print is, in fact, used extensively in the classroom with deaf students.

In a letter to the editor which appeared in the October, 1979, issue of the *American Annals of the Deaf*, I presented a position that most, if not all, the major definitions of total communication ignored the role of reading and writing in the process, suggesting that educators of deaf students tend to regard reading and writing more as skills to be learned than skills to be used. However, I continued by saying, "Any general description of communication in the classroom must include the use of the chalkboard, language slot charts, pictures and their verbal labels on the walls, overhead projection, captioned materials, workbooks, textbooks, compositions, written tests, etc."

A second answer is to say that print, unlike the reception of speech through listening and speechreading and the reception of signs and fingerspelling, does not lend itself to communication in real time. Print (and writing) is something we record for later retrieval. At least that is the way it always has been.

But technology is beginning to change all that. Under conditions such as we have [at the conference], it is now possible to convert continuous, unrehearsed speech, such as I am using at this moment, into print.

This technology became available to us in 1981 as a spinoff from other communication applications aimed at speeding up the process of transcribing spoken material into hard copy text. Court reporters had a particular interest in eliminating the laborious process of typing legal proceedings from the phonetic shorthand they entered on their stenographic machines.

However, it was left to those of us interested in applying this technology to the communication needs of hearing impaired persons to begin to exploit the real-time potential of the system for use in live situations. There have been three major applications of this real-time speech-to-text technology to our particular interests. What you are seeing today is one of these three applications--notably the large screen TV projection of a live speaker, with his or her speech being superimposed in caption form while it is being spoken, for the benefit of hearing impaired persons in the audience. NTID began to do this in its theater for deaf students and staff in 1984, and in the same year was able to demonstrate its portability in Oregon at a convention of the A.G. Bell Association for the Deaf.

*E. Ross Stuckless, Ph.D., Director, Integrative Research, National Technical Institute for the Deaf, One Lomb Memorial Drive, Rochester, NY 14623

Since that time, it has been used with some frequency at national meetings involving considerable numbers of hearing impaired persons. I might add that it has been particularly well received by organizations where most members do not use sign interpreters. Self Help for Hard of Hearing People, Inc. (SHHH) is a good case in point. I must add, however, that most communities do not have equipment and expertise for this, and, like the other applications of the system, it is not without cost.

A second application of the system is probably well-known to most of you. This is its application to closed caption television. It was introduced in 1982 by the National Captioning Institute in cooperation with ABC and its evening news department. Today, "ABC World News Tonight" with Peter Jennings continues to be captioned in real time with essentially the same technology used in this auditorium today. It has since been expanded to real-time coverage of many nationally televised special events, and is now being adopted by increasing numbers of local television stations to cover their local news and other events.

I would like to turn now to its third application, its use in the classroom. In 1982, NTID acquired a system for use in mainstream classes. Unlike the display [used during the conference], the classroom display does not feature a TV picture, but simply the appearance of twelve lines of print and up to 42 characters per line. This enables the deaf student in the class to read a lecture and discussion verbatim, as it is occurring, and to be able to look away and look back to the screen without losing anything.

Another feature is that the graphics can be stored and printed out at any time. For a more polished version, this can be edited on- or off-line. The result is that the student has access to the same information in real-time printed form as his or her hearing classmates have through listening, with the added benefit of a full transcript of the spoken information which was presented in class.

Typically, we identify three to six courses in the regular colleges of RIT [Rochester Institute of Technology] each quarter for this activity, which we call Real-Time Graphic Display, or RTGD. The courses may be selected from almost any of the kinds of courses offered at the undergraduate level in the typical college setting. Most of the courses we choose are in the liberal arts and business areas. An important consideration in the selection is the number of deaf students enrolled in the course. Obviously, we prefer to cover a class in which there may be four or five deaf students over a class in which there are only one or two.

A colleague, Dr. Alan Hurtwitz, and I have been doing this for deaf students enrolled in various colleges of RIT with hearing classmates and regular instructors (not NTID faculty) since early in 1983. Parenthetically, I should add that interpreters, note-takers, and tutors have continued to be available to these students as part of a research and development program.

Another colleague, Dr. Michael Stinson, and I developed a questionnaire which has been administered routinely to deaf students in courses using the real-time system. About seven or eight weeks into the course, we ask the students a number of questions, such as whether they understand more of the instruction through the interpreter or through the real-time print and what percentage of the actual instruction they believe they understood through each. Actually, the questions aren't asked in quite that way, but for those of you interested in more detail, an article accepted for publication by the *Volta Review* will provide more information.

Results based on 121 different students in 29 courses indicated that most of the students believed they understood more from the lectures when presented through real-time print than through interpreting and that the difference in magnitude of understanding was substantial. Without elaboration, I can tell you that these differences were statistically significant beyond the .001 level of confidence.

These same students also had trained, paid note-takers in their classes. When we asked whether they preferred the hard copy printout or notes, significantly more students chose the printouts than the notes. When we presented them with the hypothetical situation of being able to choose only one support service, 35% chose the real-time print, 30% chose the hard copy printout, 21% chose the interpreter, and 15% chose the note-taker.

I don't want to give the impression that students were unanimous in their opinions. We were interested in characteristics of students whose opinions and preferences differed. For example, significantly more graduates of mainstream programs at the secondary level than graduates of schools for the deaf selected real-time print. Children of deaf parents selected the interpreters more frequently than children of hearing parents. This information will be published shortly in the *Volta Review*. *[Editors' Note: The paper was published in the journal's December 1988 issue.]*

Now I must say that in spite of these promising results, the system at NTID has experienced virtually no growth in the classroom. Essentially this is for reasons

of cost. We are talking about two major costs. The first is the cost of the stenotypist. A well qualified stenotypist is likely to cost substantially more than a well qualified interpreter. A skilled stenotypist can command $40,000 or more a year in the legal and business environments. As you know, few interpreters in school settings make anywhere near this kind of income. The second major cost is that of the equipment and its software. Although costs have dropped appreciably since we acquired our first system, a ballpark figure today for the system (actually, there are several) might be around $25,000.

Where do I see us going in terms of classroom applications? I certainly see us continuing to do what we have been doing, partly because from a research and development standpoint we have more to learn about the processing of print in real time. This will take on increasing importance in the future when automatic speech recognition and conversion into print become practical for applications by deaf children and adults, and assuredly, this will occur.

I see us moving along two additional paths in the future: one the "high tech" path, the other the "low tech" path. The high tech path is in the direction of automatic speech recognition. If we settle for now with automatic word recognition, the state-of-the-art is at the point where some limited classroom applications may be feasible today, especially with young deaf children. For automatic continuous speech recognition, practical classroom applications may be ten years or more away. But its time will come, and it behooves us to be watchful and ready for it when it arrives. Then there is also the low tech path, to which for some reason we have not paid much attention. There are a number of personal computer software packages--Quickey, Gregg, Speedwriter being three--which are designed to enable a typist to gain appreciable speed in transcribing material through the use of abbreviations. Cost-wise, this represents nowhere near the cost of the real-time system we are now using. While these systems would not have the sophistication of the system presently under use, it is possible that they can be highly cost-effective and feasible for use with deaf students beyond NTID.

Let me say in closing that I have great faith that what we are calling real-time captioning today will lead to much improved mobility in communication for deaf people in the future. As I recently heard a deaf man say, "I can't carry an interpreter around in my pocket. I need a pocket device that translates speech into something I can read on the spot."

I have confidence that this development will, in turn, lead to major breakthroughs in the development of English reading and writing skills on the part of deaf students, and lead to opportunities which so many deaf people today are denied because English does not come easily to them.

QUESTION AND ANSWER

Question: I work as a sign language interpreter, and most of the deaf people I know prefer captioning, especially on television and in films, and I can understand that. My only question is about the undergraduate students who wanted to have real-time graphic displays instead of interpreters in the classroom. What was the mechanism for them to ask a question?

Answer: *Let me surprise you a little. I have observed a lot of undergraduate classes. Most deaf students in mainstream classes, even with good reverse interpreters, do not ask a lot of questions. The fact is that most deaf students in mainstream classes, at least at the college level, tend to be reluctant to participate in class [discussions]. That is one response. A second response is that if a deaf student has little or no speech, he or she should be encouraged to use the chalkboard and write the question or comment down. When it comes to activities like seminars and discussion groups, I do not think there is a good substitute for interpreting, given that the deaf student is able to use one.*

Question: Do you think real-time graphics are more popular among the students from mainstream high schools because they are more comfortable using their eyes?

Answer: *No, they are more comfortable using English, or perhaps I should say less comfortable using signs. Conversely, many students with deaf parents, for example, will acknowledge that they understand more from the real-time print but still prefer the interpreter. After all, if signs constitute their first language, it follows that this would be their language of choice in the classroom.*

Question: Have you looked at whether getting the hard copy has been a factor in the kids cutting classes or playing during class time?

Answer: *If they cut class, they don't get the hard copy. Actually, absenteeism has not been identified*

as a problem. But that raises another question. How do the RIT faculty take to having this system in their classes and distributing the transcripts of their lectures? I think we have involved 50 or 60 different instructors in this program and only once has a faculty member refused to participate. Some students may disagree, but, by and large, most professors take a sincere interest in their students, whether deaf or hearing, and are willing to extend themselves within reason.

Question: **You have mentioned that many of your classrooms feature captions without projection of the speaker's face. I gather you did that for economic reasons.**

Answer: *We wouldn't be able to get this system [a nine by twelve foot screen used at the conference] into a classroom. I would like to add, however, that we have done a little bit of work on speechreading in terms of the value of the large screen for speechreading. The notion is that there are a variety of communication media that a hearing impaired person can select: interpreter, speechreading, and so forth. Relative to speechreading, let me give you an analogy. If a person were ten feet away from me speechreading me directly, another person 100 feet back should be able to speechread me from the screen just as well. That is the major enhancement of a large screen. It makes speechreading accessible to everyone in the audience. We have data on that. Further, we need a large screen display here whether we have camera pictures or not. Much of the expense is for this screen. The camera is virtually free compared with the cost of a screen of this size. We need it to make the captions visible to everyone. It's quite different from a small classroom.*

More Questions and Answers on Real-Time Captioning

For some of the conference topics, leaders in the field spoke but papers were not written. Included here are questions and answers following presentations by several of these speakers.

Linda Carson
Vice President of Production
National Captioning Institute, Inc.

[Editors' Note: Ms. Carson spoke on real-time captioning in television.]

Question [Wayne Bennett]: I have been listening to your comments about live captioning. One of the problems that many deaf people have with getting local stations to caption is the cost. The high cost can't be denied. Our local TV station is trying a different approach. They are going to plug into the teleprompter computer system. The man who is the director of the news told me that this works for prescripted news, but 10% of the time you can't count on that. What is your feeling of that approach as a more economical means for a local station to do their news?

Answer: *A teleprompter is an economical way of captioning. Some stations have an electronic newsroom where you can plug in the Line 21 encoders and allow the captions to be created. The problem, as you said, is with unscripted versions. In some markets that may be 10% and in other markets, 20%. Usually the sports and weather are not prescripted. While [hearing impaired people] see most of the news, there would be big chunks of captioning missing. A little bit is better than nothing. As an economical way to caption local news, I think it is a good one.*

Question [Fred Weiner]: A few weeks ago I saw a TeleCaption 3000 on top of a television, and it struck me that the decoder device was very small. The TeleCaption 3000 had some new features and it cost about $200. I was wondering if we could come up with a smaller device without any features other than the captioning, and place it within the television set and reduce the cost of this caption feature by $35 or $40? Right now we are paying $200.[1]

Answer: *The decoder module in the TeleCaption units is a ten- or a twelve-chip module. There are twelve chips to be placed into a television system. We are working to come up with a one-or two-chip module that can be integrated into a television set at a nominal cost. The problem is the development of that one-chip module is expensive, probably somewhere in the neighborhood of a million dollars to get it down to one chip. It is something that we are looking at seriously, and the television manufacturers themselves seem receptive to the idea. At least a few of them do.*

Question: Sometimes when we are watching captioning on television, the captioning just disappears. We don't know what is going on. What do we do? I have talked with the local television station about the missing captions after a commercial, and they say they don't know what is the problem. The feed is coming from the network in New York. Sometime in the past we talked with some people at NCI [National Captioning Institute], and they blame the local stations. So there seems to be some conflict, and we get a run around on that. I think NCI should have something like a hotline where we can contact them immediately to find out if it is a local thing or nationwide so there could be a call made from NCI to the local station immediately.

Answer: *We don't have that kind of hotline now. I'm not sure it is possible. At NCI every evening we monitor all of the prime-time network telecasts that are captioned to make sure that captions are broadcast properly. If there is a network problem, we*

will call the engineers there immediately and they correct it. If it's a problem in which the captions won't appear for the rest of the program, we can generate a caption at NCI that says the program won't be captioned. If you are having problems with the captions, please remember that we are monitoring the program at NCI, and if we say it is not a network problem it is because we can see the network captions and we place the responsibility at the local level. When they get near their local news at about 11 p.m., the local stations have a tendency to switch things at their master control. That could delete the captions. Local stations are learning to be more responsive to the deaf community, and I think we just have to keep encouraging them to listen to your complaints.

Question: I was talking with some people at a local station about installing a TTY in their office so we can call them directly. But they continue to blame things on the national network. I think something has to be done to solve the problem immediately.

Answer: *If you can give me the name of your local station after this meeting, I will make sure that our engineers talk to them directly and see if we can straighten it out in your area. I would like to add that from the day that NCI first went on the air, this enforcement has been a problem. It's impossible for NCI or any other entity like NCI to monitor all broadcasts of all captioning. We do rely very much on the audience to give feedback to their local stations. I have talked to engineers at many local stations, and they try to bounce the problem back to the national level. Most of the time they don't realize the many different things they can do to affect the caption part of the transmission. There are over 1,000 television stations in this country and 18,000 cable companies. It's impossible for NCI or any other national company to be able to watch the signal of every program everywhere it is transmitted. For example, we captioned one of the 1988 political conventions recently. It was on CBS and NBC, and NCI captioned it on ABC. Simultaneously, there were about 700 television stations carrying the convention with captions. We did receive a complaint after the convention that one station had done something to affect the captions. It took us almost a day of talking to engineers to find out where that problem had occurred, and it had occurred at the local level.*

The local area is almost always the problem, but when we want to find out why the captions don't work, we have to find out so much information that it becomes impossible. For example, did the viewer watch it on cable? If it was a cable signal picking up a local TV station, and the local TV station is picking up the signal from a network there are so many places that problems can be introduced. It is a very difficult thing to track back. It's impossible to trace it during the program. So it's a process of getting the consumer to call or write to the local station after the problem has occurred and educate the local station. There are people watching captioning, but many of the local stations don't even think about it. Captions just pass through their signal, and they aren't aware that they can affect it. Educate them that you are watching it. Educate them that there has been a problem. Most stations will not throw the blame on NCI or even the network. Most stations will pick up the phone and make the call themselves. If you don't get that kind of satisfaction, go higher in the station because by the time you get to the station manager they know that it is not up to you to find the problem. It's up to them.

Question: The problem is the loss of captions. We need someone to call--some sort of hotline--somewhere in the United States, you know. A station goes out in another part of the country, they ought to be able to call a central place like NCI to say, "Hey, it has gone out." I mean, it would solve a lot of problems. When you are talking about calling and writing a letter and everything, it just takes so much time. If hearing people are missing their audio, they just simply call their local station and start to complain. We can't do that. We should have some sort of a hotline, maybe at NCI, so we have a way of contacting the station. We could tell the hotline what station in what town and say, "Hey, look, the signal is gone." Somebody can call and alert them to that fact.

Answer: *NCI tried that in the beginning, and it was impossible. The information that we were getting from consumers made it impossible to trace the problems. Sometimes it took as many as two or three weeks to trace the problem, so a hotline that deaf people could call will not solve that problem. It's an education problem. We have found that the stations, and especially cable companies lately, are affecting the signal. I understand your frustration. It is also very frustrating to those of us who spend many hours preparing the captions only to learn that you don't see them. Or that something is introduced that makes our captions have mistakes, and you think that we don't know how to spell. In the early days NCI tried to set up a hotline, and it solved almost no*

problems. It's a very, very tricky thing. The thing that has cut down the number of problems is educating the local stations and cable companies as to what their responsibilities are.

There is a slightly different angle to the answer to your question. We were part of a project involving the Federal Emergency Management Agency and the National Association of Broadcasters to develop televised emergency messages for deaf persons across the country. It would tell them whether there was going to be a tornado or the bridge was out or whatever the local or national disaster was. They would be able to put up an emergency message in ASL and captions that would tell the audience to stay tuned. That sounds like a simple thing but in addition to that, each station made a commitment to make any information that was told to the hearing public available visually to deaf members of their audiences. That commitment involved an educational experience on the part of management. They needed to know what to tell their engineers in order to make the information come up on a character generator or printed on the screen or whatever. But it was for emergency situations. We were able to reach a lot of stations that had, up to that point, not been reached by the concept that they had deaf audiences, and that emergency situations could be critically important. Interestingly enough, the project was developed by a blind gentleman, a deaf producer here at Gallaudet, and several hearing engineers. I think it helped add to the educational environment. Every time there is an opportunity to explain that the audience is there and that there is an opportunity to communicate with the deaf, we will have more stations behind us in understanding a little more of what is happening.

Question: I don't know how many hours NCI is providing captioning for television programs, including HBO and all those networks. How many hours a week are you producing?

Answer: *We actually produce about 60 hours of live captioning a week and about 70 hours of pre-recorded captioning a week. That's how much we produce. How much is broadcast depends on how many repeat movies HBO wants to show that week or that month. But I think you could probably look at 200 hours, depending if you are on cable or pay cable or not.*

Question [Jack Levesque]: Is NCI nonprofit? What is your total budget? What percent is federal money? Do you have a board? What percentage of your board is deaf?

Answer: I think we have 12 full board members, and three of them are deaf: Frank Sullivan, John Yeh, and Roz Rosen. I don't know the total budget. I know that between about 40 and 50% of our programming is funded with government money. We are nonprofit.

Question [Elise Burke]: What do you think is going to be happening in the near future with respect to captioning of programs?

Answer: *Until the audience for captioning is of sufficient size where it makes economic sense to support more closed captioning, we may not go much further than we are today. Thank goodness we have a lot of federal funds available to put more captioned programs on the air, but it's difficult to sell more sponsors than we have now on the whole idea of captioning because the audience isn't of sufficient size for them to justify that investment. But with the recommendations by the Commission on Education of the Deaf and the bill in Congress called the Americans with Disabilities Act of 1988 (both of those bodies recommending that all programs be captioned), I think, depending on the strength that those bills and recommendations carry, it will have a significant impact on the willingness of broadcasters to participate more.*

Daniel Hinton
Senior Communications Engineer
Science Applications
International Corporation

[Editors' Note: Mr. Hinton addressed the topic of deaf-blind access to captions.]

Question: The TeleBraille is basically a TTY with a Braille machine?

Answer: *Yes. It was done by Telesensory Systems, Inc. [TSI] in California. They took the Superphone*

(made by Ultratec), added a computer chip or two and outputted it to a Braille display unit which they had developed.

Question: Is there an internal modification that could be done for the TeleBraille which would allow a Baudot-to-ASCII conversion?

Answer: *The bottom line here is cost. We [at SAIC] could make an internal modification but it would mean bringing in each one of their sets to be modified. If we do anything to it, it costs $600 every time it has to be repaired. It would cost more for repair than it would to buy our whole system. Yes, our system is slower because it's only 45 bits per second but it is still fast enough for the audience we are working for. We encourage them to buy their own computers because they can get them cheaper if we don't have to handle it. We just modify the TeleCaption decoder and provide them with the telephone handset and the cartridge.*

Question: I was wondering, can your system also be modified to record phone conversations?

Answer: *The best way to do a phone conversation is just to record your TTY phone conversation. Buy one of those little telephone microphones. Record it on a regular tape recorder, and then if you want to play it back later, you can. (The TTY message is just two tones coming out of your tape recorder.) You can record your telephone calls with a TDD very inexpensively. Radio Shack sells the microphone for about $5, and the tape is even cheaper. You have a half-duplex system, which means you transmit to the other system and they type back to you. You don't have both sets of tones going at the same time. So there is no reason why you can't record your telephone conversation.*

Question: It can be used as a two-way communication system then?

Answer: *No, we are developing a two-way communication system. The Braille TeleCaptioning system only takes the information from the TeleCaption decoder into the computer and gives it to the person. We are now working on a system that will allow the TeleBraille to actually two-way communicate with the computer. We have a grant for that from the National Institute on Disability and Rehabilitation Research.*

Notes

1. Cost of the TeleCaption 3000 is presently $179-$199.

Section III

AUTOMATIC SPEECH RECOGNITION

Judith E. Harkins, Ph.D.
Session Chair

James Glenn, Entropic Speech, Inc.

AUTOMATIC SPEECH RECOGNITION: THE BASICS

*James Glenn**

Automatic speech recognition (ASR) is often cited as the "most natural" human-machine interface. In a very broad sense that is undoubtedly true. After all, spoken language developed before written language. However, neither current knowledge of human speech perception nor the capability for automating that process is sufficiently developed to support the implementation of true natural language interfaces with computers. It is possible to "talk to computers," but not in the sense that you would normally converse with another human being. The "conversation" must be limited in both scope and style, and requires significant discipline on the part of the speaker. Given these constraints, currently available ASR technology still has practical and beneficial applications.

The goal of this paper is to introduce the terminology used to describe ASR technology, explain what can (and can't) be done with today's technology, and indicate probable evolutionary trends.

Terminology

The lack of standardization of terminology is an acknowledged problem in the emerging field of speech technology. One reason for this problem is that workers in the field come from a wide variety of academic and professional backgrounds, e.g, engineering, linguistics, mathematics, medicine, and psychology.

The following are some basic definitions used in discussing ASR technology. Items that are starred are definitions that have been proposed by David S. Pallett of the National Bureau of Standards in an attempt to establish uniform terminology (Pallett, 1985).

Vocabulary*--The words or phrases to be recognized by a recognizer. Distinctions should be made between the complete set of all words and phrases that a recognizer has been trained or programmed to recognize, sometimes called the total *recognition vocabulary*, and the (instantaneously varying) subset of these that may be active at a given time because of an imposed task grammar or other syntactic constraint, called the *active vocabulary*.

Syntax*--Structure by which grammatical word sequences are specified.

Enrollment*--The process of constructing representations of speech, such as template sets or word models, to be used by a recognizer. Also referred to as "system training," as distinct from "user training."

Utterance*--A word or multi-word phrase spoken continuously as a single unit.

Articulation--Movement of the speech articulators--tongue, lips, teeth--to produce specific speech sounds.

Coarticulation--The overlapping of articulation associated with adjacent sounds.

Categories of ASR Technology

ASR technology can be categorized in two dimensions. One relates to the manner of speaking,

*James Glenn, Manager, Development Programs, Entropic Speech, Inc., Washington Research Laboratory, 600 Pennsylvania Avenue, S.E., Washington, DC 20003

the other to the method for accommodating the population of speakers. The following definitions have been proposed as standard terminology for discussing speech recognition technologies.

Manner of Speaking

Three distinct methods of speaking have been identified:

Isolated Words*--Words spoken with pauses (typically with duration in excess of 200 milliseconds) before and after each word.

Connected Words*--Words spoken carefully, but with no explicit pauses between them.

Continuous Speech*--Words spoken fluently and rapidly, as in conversational speech.

Discrete utterance recognizers have a throughput limitation of approximately one utterance per second. A connected word recognizer may be able to process speech at up to three words per second.

The most frequent abuse of this terminology is to characterize a connected speech recognizer as a "continuous speech" recognizer. The difference between connected speech and discrete speech is a high degree of "coarticulation." True continuous speech recognition is an extremely difficult task.

Accommodation of Speaker Population

There are also three methods of accommodating the population of speakers. These are:

Speaker Dependent Recognition*--A procedure for speech recognition which depends on enrollment data from the individual speaker who is to use the device.

Speaker Independent Recognition*--A procedure for speech recognition which requires no previous enrollment data from the individual who is to use the device.

Adaptation*--The automatic modification of existing internal machine representations (e.g., template sets, word models, etc.) of specific utterances and/or noise.

Speaker dependent recognition usually implies that enrollment samples are collected for each word or phrase to be recognized. However, some large vocabulary systems are able to ***adapt*** to a new user on the basis of an enrollment session that only covers a subset of the total vocabulary.

Adaptation is also used in another sense in some currently available products to add a sample to an existing template or word model based on the most recent utterance. This form of adaptation permits system training to continue beyond the initial enrollment period into operational usage. It is a potentially powerful technique for accommodating changes in voice patterns due to fatigue, stress, or a varying acoustic environment. Adaptation may be key to achieving accurate performance via highly variable telephone channels.

Possibilities for Error in ASR

These are some of the things that can go wrong during ASR. Deletions and insertions are problems that are particularly serious in connected or continuous speech recognition.

Deletion*--An instance in which a spoken word is ignored, and for which the recognizer or system provides no response (e.g., in recognizing a string of digits, if the recognizer returns one less digit than has been input).

False Acceptance*--An example of failure to reject properly spoken input utterances that are not part of the active vocabulary, resulting in selection of a word in the active vocabulary.

Insertion*--An instance of a recognition occurring due to spurious noise or an utterance other than those that are legitimate on syntactic considerations. In the former case, some input other than an utterance (typically some ambient or electrical noise artifact) is not properly rejected and the system response indicates that some utterance in the recognition vocabulary occurred. In the latter case, a word that has been uttered (but which is not part of the active recognition vocabulary because of current syntactic constraints) is falsely accepted as an utterance from the active recognition vocabulary.

Rejection*--The property of rejecting inputs. There are three general classes of system response involving rejection: i) noise rejection, ii) rejection of improperly spoken input utterances, and iii) rejection of properly spoken input utterances that are part of the active vocabulary, sometimes termed false rejection.

Substitution*--An instance in which one word in the recognition vocabulary is incorrectly recognized as another word in the recognition vocabulary.

In spite of all these possibilities for error, there are many ASR products that perform successfully in the right application.

Strategies for Speech Recognition

Existing strategies for automatic speech recognition range from fairly simple pattern-matching devices to rather complex speech understanding systems that incorporate natural language models in their decision strategies.

Two classes of speech recognition systems are described in the following sections. Each class utilizes different sources of information (or "knowledge") in making recognition decisions.

Whole-Word (or Utterance) Template-Matching

The simplest ASR systems accept a limited repertoire of single words or short phrases spoken in isolation. Each utterance is bounded by silence at both beginning and end. These short pauses of silence, often termed "word gaps," make detection of the unit to be recognized quite reliable. Also, since each utterance is considered as a unique, cohesive event, coarticulation effects are isolated within the recognition unit. Systems that perform recognition in this fashion are termed "isolated word" or "discrete utterance" recognizers. One or more reference templates are used to represent each utterance that can be recognized by the system. The vocabulary capacities of such systems range from a dozen or so items to over 1,000 words and phrases.

Discrete utterance recognition systems may be either "trained" to respond to an individual speaker or may be programmed to respond to a limited vocabulary, independent of the individual speaker. Systems that are trained by each speaker are termed "speaker dependent." Systems that are preprogrammed to respond to a general population of speakers without specific training by individual users are termed "speaker independent."

Speaker dependent, discrete utterance recognition technology is economical in cost and fairly robust in performance. This is the most widely used technology to date. Speaker dependent systems capable of recognizing "connected" words are also available. Connected speech recognizers do not require a gap of silence between utterances. Therefore, they allow more rapid input of spoken commands (up to three times the rate of discrete utterance recognizers). However, connected speech recognition systems may require an extended training period to build coarticulation effects into the word templates. Connected speech recognition systems also tend to be more susceptible to noise interference, and they are more prone to "insertion" and "deletion" errors than are discrete utterance recognizers. The decision to use discrete, or connected, speech recognition technology ultimately depends on application requirements, e.g, nature of the vocabulary, throughput required, and noise environment.

Speaker independent systems have found application in some telephone-based information retrieval systems, and in voice dialers--particularly for cellular telephones. Vocabularies, however, are usually restricted to 20 words or less, and often to ten digits plus a few control words. The state-of-the-art of speaker independent technology has not advanced as fast as speaker dependent technology.

Figure 1 summarizes the performance characteristics of word recognition products currently being marketed.

Figure 2 is a functional block diagram of a typical speaker dependent speech recognition system. The various processes performed by the system are described in the following sections.

Signal Processing and Feature Extraction

The speech signal input to the system may be supplied directly from the output of a microphone or may be received as the output of a communication channel, e.g., a radio or telephone link. Signal processing typically includes a filter to shape the resulting bandwidth, and amplification to a nominal signal level. Then the signal is subjected to a transformation producing the features desired for pattern matching. The two most frequently used transformations are bandpass filtering and linear predictive coding (LPC). Both model the spectrum of

	$/WORD[1]	NOISE[2]	TRAINING[3]	VOCABULARY
DISCRETE/DEPENDENT	1-15	90dB +	2-8 pass	200-1000
CONNECTED/DEPENDENT	20-50	90dB –	2 + +	50-100
DISCRETE/INDEPENDENT	50 +	?	(100 +)	20

Figure 1: Typical ASR Performance Characteristics

[1] Cost for board, peripheral, system products. Component costs may be less than $1/word.

[2] The 90dB noise level shown is somewhat arbitrary. The important point is that discrete recognition algorithms have proven more survivable in high noise environments than connected technologies. Because speaker independent recognition is most commonly employed in telephone applications using exisiting handset microphones, a high sensitivity to noise should be expected.

[3] Although speaker independent systems require no training by individual users, their reference templates are typically derived from a large sample population of speakers. Thus there may be a high "training" cost involved in adding vocabulary to such a system.

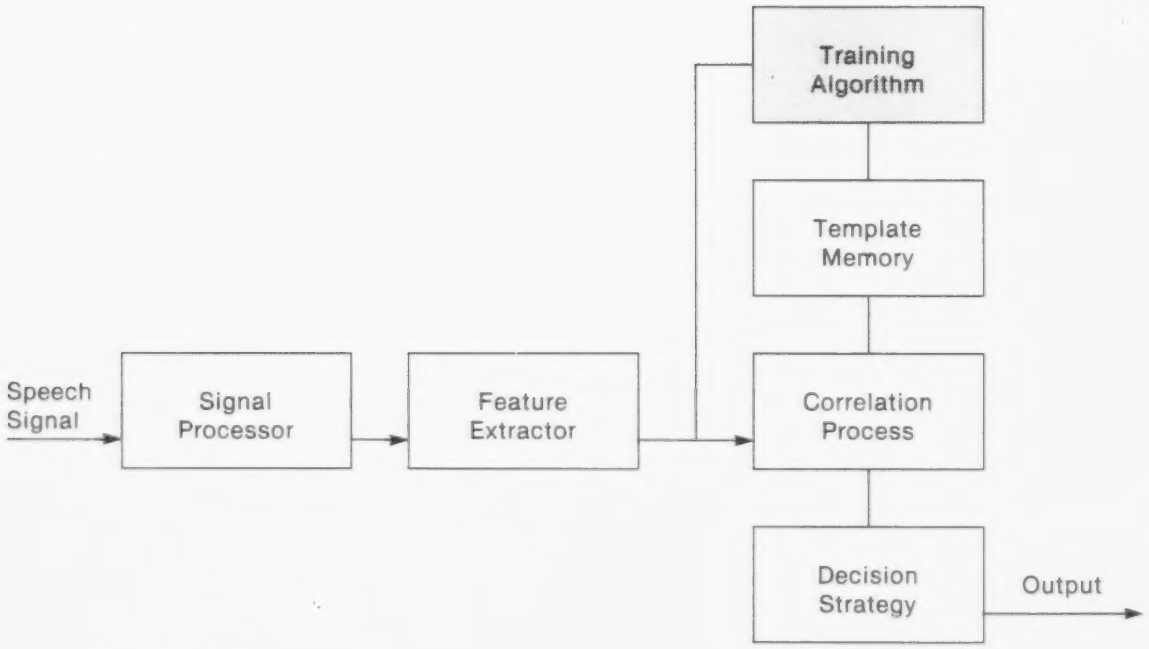


Figure 2: A Template-Matching Speech Recognition System

the acoustic signal, thus including information about the configuration of the vocal tract. Either method typically produces eight to 20 "features" roughly 100 times a second. The resulting features are then used to determine the presence of utterances, to develop reference templates representing the vocabulary of words and phrases to be recognized, and to determine the identity of unknown utterances produced after "training." Most contemporary speech recognition products utilize digital signal processing components to perform the feature extraction process. The seemingly low sampling rate required for speech processing is due to the fact that the mass of the human articulators constrains the rate at which the resulting acoustic signal can change.

In discrete utterance systems, a word boundary detector is typically employed to determine the beginning and end point of each utterance prior to processing for training or recognition. The word boundary detector may be very useful in eliminating non-speech signals prior to the template-matching process. In connected word speech recognition systems, boundaries can only be determined by continuously correlating the input signal against templates for permissible vocabulary items. This increases the processing workload significantly, and also increases the probability that the extraneous noise unintentionally will be classifed as spoken input.

"Training" the Recognizer

Input signals that pass the decision criteria of the word boundary detector are processed for training or recognition, depending on the mode of operation selected. The training algorithm box is shaded to indicate that the training process may be off-line with the recognition process carried out in day-to-day operation. During training, the system forms one or more reference template for each vocabulary item. This is accomplished by eliciting token utterances from the user and recording either the feature pattern itself or some estimate of the distribution of such patterns in the template memory. Available speech recognition products typically require one to three "training" tokens for each vocabulary item prior to recognition operation. Most systems also provide a mechanism for updating the template memory with additional tokens in order to better represent the total range of variation for the speaker. Some systems provide an automatic template updating mechanism that is invoked during recognition operation whenever an interesting variation in pronunciation occurs. Whatever the mechanism, it is essential that the system obtain a good estimate of the full range of variation of each user's speech. Refining the training process has had a significant effect on the robustness of recognition performance, and on the acceptance of the technology by users.

Operator voice templates, once established through the training process, typically are stored on some nonvolatile memory medium, e.g., disk or bubble memory. The templates are then available for immediate loading at shift sign-on, or whenever the operator needs to use the system. Speaker dependent technology has the advantage of providing an audit trail via the template set of the individual operator.

"Speaker independent" recognition systems actually rely on a similar template-matching architecture. The difference is that the templates are derived independently of the individual speaker. An off-line training procedure is used to build a generalized set of patterns based on tokens collected from a large number of speakers of the same language (or even dialect).

Recognition Operation

Once reference templates are loaded for an application, the recognition system correlates patterns from new utterances with the templates in memory to determine what was spoken by the current operator. This process is often refined by employing a "syntax" processor to limit the search of the template memory to those templates that bear relevance to the operator's immediate task. For instance, if the operator is being asked to enter a numeric quantity, the system needn't correlate the spoken response with a list of descriptive terms for reporting quality defects.

The correlation result is passed to a decision process to determine whether the result is sufficiently positive and unambiguous to produce an output. If a low correlation results, the utterance may simply be rejected as not relevant to the immediate task. This is the desired result if either environmental noise or irrelevant speech is entering the system. If the correlation value is high for a particular relevant template, and if no other templates produced a similar high value, an immediate decision may be output. If the correlation result is unclear, either because of a moderately weak correlation value, or because two or more templates produced similar correlation values, the system may request more information from the speaker. The system may ask the speaker to repeat the input in this case. Another strategy employed with considerable success in some recognition systems is to respond to

an uncertain correlation result by asking the operator, "Did you say x?" where "x" is the highest scoring vocabulary item. This strategy seems to help reduce operator frustration, which can build up if the system produces too many heartless "rejects."

Recognition Using a Statistical Model of Language

Whole-word pattern-matching is an effective recognition technique for applications requiring vocabularies limited to a few hundred words or less. For very large vocabularies composed of thousands of words, the requirement to provide training samples for each word is considered untenable. Furthermore, a language model is required to resolve ambiguities between the many acoustically similar candidates for the system output.

Figure 3 illustrates the general architecture of a well-known large vocabulary speech recognition system developed at the IBM Thomas J. Watson Research Center (Hoskins, 1985; Jelinek et al., 1985).

Whereas whole-word template-matching recognizers rely strictly on acoustic information in their decision process, the system shown in Figure 3 incorporates language statistics as well as acoustic information in the decision process. Furthermore, this large vocabulary recognition system does not require training tokens for each word in its vocabulary. The system estimates speaker-specific characteristics based on a training sample consisting of several carefully constructed sentences. The individual processes in the system are described in the following sections.

Signal Processor

Signal processing includes preamplification of the microphone output, followed by low-pass and high-pass filtering to band-limit the signal to the range between 200 Hz. and 8 kHz.

Acoustic Processor

Twenty acoustic features are sampled on a centisecond basis. Using vector quantization, each sample is assigned the label of one of 200 speaker dependent prototypes formed during the training session. The 200 acoustic prototypes are derived by automatically clustering the set of all acoustic events that occur during the training operation. This is a pattern-matching operation.

Linguistic Processor

Recognition results are hypothesized based on the observed acoustic labels output from the acoustic processor. The estimated probability that a word has occurred is based on the acoustic label sequence, a phonetic model for the word, and the probability of that word given the two preceding words, as specified in the language model. Each word in the vocabulary is represented by one or more strings of symbols from a phonetic alphabet. Each phonetic symbol is represented by a hidden Markov model that is "tuned" to the speaker on the basis of the initial training data. Thus, both the acoustic processor and the linguistic processor are adapted to the individual speaker.

The language model, which was designed to support a memo-dictating task, was derived from a data base of over 100,000 business letters and memos. The present 20,000-word vocabulary represents a substantial increase beyond the 5,000-word vocabulary that was utilized in a 1985 version of this system.

ASR Strategies Summary

The two strategies for speech recognition discussed above differ significantly in the amount of information utilized in their decision processes. They are also at very different stages of development.

Whole-utterance template-matching systems utilize only the acoustic information in the speech signal. Because these systems make no explicit assumptions about language, they can, with proper vocabulary selection, be operated by speakers of almost any language or dialect. Within their vocabulary restrictions, these systems are easily adapted to new applications. A wide range of template-matching speech recognition products are available. In fact, most speech recognition systems used in operational environments to date are of this type.

The large vocabulary "dictation" systems utilize both acoustic and linguistic information in their decision processes. The linguistic information encompasses phonetic models and word transition statistics, but stops short of semantics. These systems are language-specific. Products are just beginning to be marketed. However, these systems require speaker adaptation for accurate operation, and are not designed for use with telephone input.

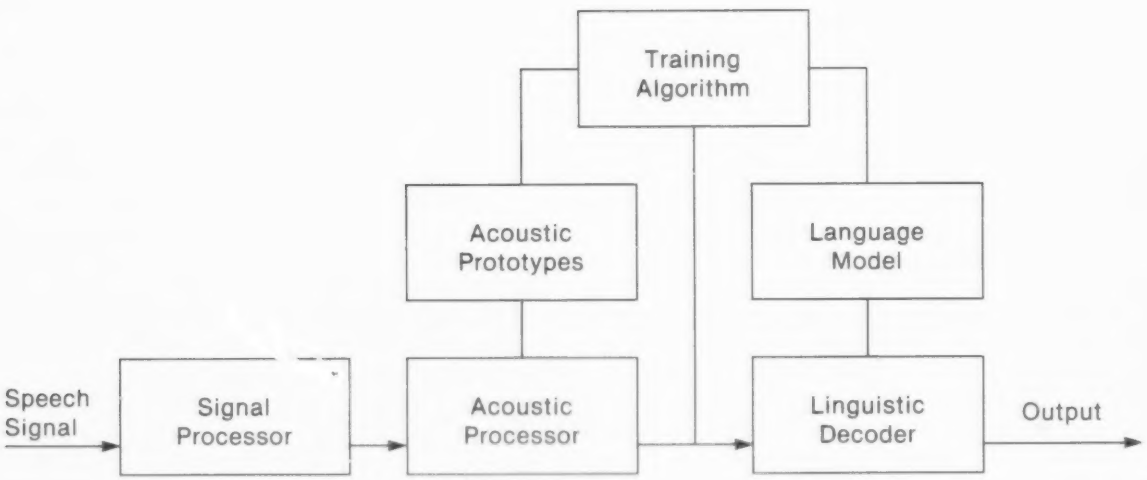


Figure 3: Recognition System with Language Model

Implications for Relay Service Application

Three of the critical technology "frontiers" for ASR are:

- Large vocabulary recognition (currently limited to approximately 5,000 words in products).
- Speaker independence (currently limited to very small vocabularies).
- Robust operation over the dial telephone network (currently limited to very small vocabularies or known speakers).

It is likely to be a long time before the speech industry can offer speaker independent recognition of very large vocabularies continuously spoken over the dial telephone network. Significant advances on all three frontiers are required to completely automate relay services. However, it is worth considering what *can* be done with existing technology. For instance, is it possible to handle a significant percentage of calls automatically while routing others through human operators? In a high volume application, such a "skimming" strategy can be highly effective even though a total solution is not available.

A high percentage of telephone calls originated or received by most individuals do not involve strangers, but known parties. Thus, it may be possible to use speaker dependent recognition for some volume of relay service. The vocabulary required is also a function of the party called (or calling), so it may be possible to employ smaller call-specific vocabularies for many calls. (One does not need to discuss tax matters with the Kennedy Center, and one does not order theater tickets from a lawyer.) Also, most recognizers permit vocabulary "overlays," permitting piecewise expansion of the total application vocabulary as a function of the current syntax.

A plug-in board for a personal computer, capable of automatic telephone signaling, touch-tone decoding, speaker dependent ASR, and high quality text-to-speech synthesises can be purchased today for less than $1,500 in single quantity. The addition of some creative software might provide a partial solution to the problem of automating relay service.

References

Hoskins, J. (1985). Large vocabulary speech recognition--today at IBM. *Speech Technology, 3*, pp. 16-21.

Jelinek, F., et al. (1985). A real-time, isolated-word speech recognition system for dictation transcription. *Proceedings, ICASSP 85, IEEE International Conference on Acoustics, Speech, and Signal Processing*, pp. 858-861. Tampa, FL.

Pallett, D.S. (1985). Performance assessment of automatic speech recognizers. *Journal of Research of the National Bureau of Standards, 90* (5).

QUESTION AND ANSWER

Question: Are any languages other than English better suited to speech recognition?

Answer: *Yes, Japanese. The Japanese language is very phonetically regular--it's consonant, vowel, consonant, vowel. And so, for speech recognition technology, it is an easier language. Also, there are very few non-native speakers of Japanese, whereas in our country we have a significant group of our population not native in English. So in that sense, some languages are probably easier to automate. There was a Swiss researcher who years ago invented a language especially for speech recognition. He used to send me Christmas cards written in it: "tee, ta, tow, zee, zoy." It didn't catch on. We will have to solve the problem for English.*

Question: I wanted to ask about looking at things from another side. What about going from text to speech, like a TTY to voice?

Answer: *The good news is that speech synthesis is a much more available technology. We have pretty good text-to-speech systems today. In many of the recognition systems I have worked with in automobile plants and so forth, I used text-to-speech synthesis to generate the prompts and verification to the operator.*

The quality is not perfectly human, but good enough to be intelligible. And I think there is great hope that will improve. That area will become more natural sounding in the very near term. I'm very hopeful about that possibility.

Question: I didn't hear you say very much about the impact of background noise. I would assume that it is as much of a problem for speech recognition as it is for speech discrimination with a hearing aid.

Answer: *Yes, in fact, it may be more of a problem. The solution today largely is the noise cancelling microphone. The one we are using on the stage is the industry standard. The Shure Brothers SM10 microphone will allow you to work in an average room up to 90 dB, which is pretty loud. It is much louder than a normal office environment. The nature of the background noise is also very important. If the background noise is speech, the problem is that this microphone only works if it is within half an inch of your mouth, which is why you need the headset. You can't wear it on your tie. It is quite effective in reasonably high noise environments. It's a problem that I think in most cases can be solved. The worst case is probably the telephone line because the typical telephone handsets are bugs, and they pick up noise. There are, in fact, noise cancelling microphones that can be applied to the telephone. But if you want to open the system to a worldwide network, most of your telephone handsets will not filter out the noise, and you will have a lot of noise to deal with. That will be the determining factor in working through the telephone system.*

Question: I wonder if you would look in your crystal ball and speculate whether more powerful processors, parallel processing, and faster processors are really going to help the performance of these systems, or whether you think other limitations are more limiting?

Answer: *Technology is changing very rapidly. By having faster computers and parallel processors and so forth, why can't we build better speech recognizers? In fact, most people who are working at the forefront of this research are counting on those technologies. It is the kind of thing that will help you move faster from discrete recognition to connected recognition to continuous recognition. You need a lot of processing to find out where the word began.*

Unfortunately, we have some more fundamental problems. It isn't just a matter of finding a big enough lever and a place to stand to move the earth. We don't know much about how people recognize speech, and it is the fundamental lack of understanding about how we do it ourselves that is more of a limiting factor than the computer processing power. Some people say that speech recognition systems, even with computer processors on them, are pretty simple-minded when you compare them with what a human can do. Better processing will help, but it won't solve the problem.

Question [Nancy Connors]: Does pitch make a difference in the ability of the machine to understand speech? [Glenn: Are you talking about the difference between males and females?] Yes.

Answer: *There is a lot of mythology about that. I find that most of the recognizers I have dealt with are not really biased on the basis of male versus female. They don't have a sexual bias. They are all developed in laboratories by males, and they have a little male bias and so forth, but I haven't seen much evidence of that. I put a system in textile mills in Georgia, a system that over 300 people a year use. More than half of the users are women, and we don't see any difference in performance between the women and men. Now, just two weeks ago at a conference on the west coast, there was a person from Smiths Industries Aerospace and Defense Systems in England who presented a paper on what happens to helicopter pilots. It turns out as the noise gets very high–like 120 or 130 dB–pitch may actually double. They showed the pitch changing from 150 cycles per second to 300 per second just trying to scream through the noise, I guess. That certainly does affect performance. One of the worst effects of the noisy environment is that noise affects the way a person speaks. If a person is going to work in a noisy environment, the enrollment needs to be done in that environment. If the environment is changing, then you are going to have to have some form for that adaptation. A very dramatic change in the pitch of the individual speaker is a function of tension or noise or something, I would think. The difference between, say, the average pitch of males and females is a red herring.*

[Moderator: Please mention the concept of "sheep and goats."]

We should mention sheep and goats. I had a slide on sheep and goats but I didn't bring it with me. I think we can attribute this term to George Doddington at Texas Instruments. Sheep are people for whom speech recognizers work. Goats are people for whom they don't, and George Doddington will admit that he is a goat. Now in this textile plant application, out of the 300 people that used this system in several plants, there may be some people who have a terrible case of "mike-fright" or someone who stutters or who is spastic or who has a random kind of speech production, who may not be able to use a machine like this. The simpler machines--the template matchers--don't care whether your speech sounds normal or not.

I think there may be some hope here for people with a hearing impairment if you can speak consistently. Even though it doesn't sound, quote, "natural" to someone else, it may sound just fine to the machine. If you have a synthesizer on the other end, it would be able to produce speech also.

Judith E. Harkins, Gallaudet Research Institute

APPLYING ASR TO COMMUNICATION BETWEEN DEAF AND HEARING PEOPLE

*A presentation by Judith E. Harkins**

In talking about applications of speech recognition technology, I'd like to begin by reviewing some of the basic concepts that Jim Glenn presented, that is, the variables in speech recognition systems that we need to keep in mind as we look toward the future and think about the applications that are of interest.

First of all, the manner in which the hearing person has to speak in order for the speech recognizer to work properly: isolated-word speech with significant...pauses...between...words, versus connected speech spoken clearly, versus continuous speech where all the words run together as they do when people talk naturally.

Second, the accommodation that's required of the speaker population: how much time the hearing person has to invest in training the speech recognition system on his or her voice before the system will recognize speech. Some systems require training to a particular speaker's voice before they will correctly recognize words. Others are speaker independent and can understand anyone's speech (current systems of this type are limited to very small vocabularies). Adaptive systems can improve in their performance on a person's speech just by having that person use the system more and more over time, so that the system becomes more aware of the person's speech patterns, idiosyncrasies, and changes.

Another variable is the size of vocabulary. For the applications of interest to us, vocabulary size is an important issue because we want to have unconstrained conversation between hearing impaired people and hearing people.

Then there is the question of processor lag. You will see in the demonstration of a large-vocabulary system that, as with real-time captioning, there is a little bit of delay between the time a person speaks and the time the words appear on the screen. Depending on the processor and depending on the complexity of the utterance, the lag could be significant.

Perhaps more significant are the errors that recognizers make. This is an area that has been studied somewhat. There have been studies of recognizers at current performance levels or cutting-edge performance levels and how they might be used despite their limitations. There have been studies of how displays for these systems can be designed so that perhaps some hearing impaired people could use them even though the systems do make errors.

Different kinds of errors cause different kinds of problems. When recognizers make substitution errors, the substitute word sometimes doesn't look like a word that is phonetically similar to what the speaker actually said. In real-time captioning, for a fairly large percentage of the time, the error at least can be "sounded out" so that often, depending on the skills of the person reading the text, it is possible to guess what was actually said. A speech recognition system is more likely to present a word that is confusing because its pronunciation doesn't give any clues.

Last year, Carl Jensema, Al Sonnenstrahl, and I travelled across the United States and held discussion groups with deaf and hard of hearing people. We were talking about technologies that make use of the person's sense of sight and sense of touch. We were not talking about hearing aids or assistive listening systems because of the nature of our grant. With this limitation on the topic we found that among both deaf and hard of hearing people, speech recognition technology popped up again and again in their requests for future developments. We were surprised at the level of awareness that people have about the particulars of speech recognition technology.

*Judith E. Harkins, Ph.D., Director, Technology Assessment Program, Gallaudet Research Institute, Gallaudet University

Sometimes the information about speech recognition was wrong or slightly off base. Sometimes the expectations were a little high because of some things consumers had seen on television. But there was a clear indication that people are attempting to track speech recognition technology because the appeal is so strong. It is very important that we--the consumers here and people from universities, from telephone companies and other businesses--continue to track this technology. It is important that we examine it critically, with a spirit of hope for ingenious uses, but at the same time evaluating it in light of the environment.

In a focus group discussion where people are free to throw out any ideas they have, there is a tendency for people to project far into the future for the most convenient device. One of the main ways in which hearing impaired people would like to use automatic speech recognition is in face-to-face communication with hearing people. People envision something they can carry around that would understand the speech of the hearing person and print it out. There is no mention of possible encumbrances that might go with it. Most people don't seem to think, "I would have to carry a microphone that I would put in the person's face the way you do with an assistive listening device."

Face-to-face communication is one of the more demanding applications of speech recognition technology. Settings such as gas stations, restaurants, and stores where you have a wide variety of speakers and noise conditions, are the kinds of environments that hearing impaired people are very interested in. They're also interested in using speech recognition for family gatherings and meetings, for employment as well as home life, lectures, and theater to be able to improve communication.

Yesterday we mentioned instruction as another face-to-face situation where you have a single speaker or a limited number of speakers, and you want to be able to caption what is being said to a larger audience of which hearing impaired people are part.

People want to be able to use speech recognition for telephone communication. Telephone communication seems like an ideal application. In face-to-face communication there are a fair number of substitutes that you can use--note-writing, lipreading, things that people do already. But for telephone use, speech recognition seems especially appropriate because the two people cannot see each other and cannot resort to other forms of communication if the hearing person doesn't have a TDD.

Of course, the goal is to have a system that does not require the hearing person in the conversation to have any kind of device. This means that you can't have a special microphone on the hearing person's phone. The speech recognition system will therefore have to understand the voice as it is transmitted by the telephone system, which is a degraded form. Because the hearing person would have no visual display, that person will have to give the hearing person feedback verbally if the system is having problems with the speech, or if the hearing person needs to press a key on the touch-tone pad.

Captioning is another possible application for speech recognition technology. Of course, we have become used to how nice captioning is for hearing and hard of hearing and deaf people to be able to follow a lecture. To be able to automate captioning even to a small extent might make it possible to improve the amount and the quality that is available.

We need to keep in mind some questions as the technology continues to mature, and as we continue to see product announcements about new forms of the technology. By the way, if you look on the back of Jim Glenn's handout, he has listed some organizations and some publications that will help you keep up with developments in speech technology. Some of [the publications] are not terribly technical. *Speech Technology*, of which Jim is editor, deals with applications of speech technology, and is quite interesting reading for a wide audience. So I would recommend that you look into that.

We have to consider, first of all, for any given application and for any given product, *who is the hearing person* in the communication? Is it someone like a relay operator who could be trained, who would wear a headset, who is a cooperative hearing person because the person is being paid to do a job well? Or is it a gas station attendant? (I just had some experiences recently with some rude gas station attendants near my home so that's why I use this example.) The hearing person may be someone who is not likely to cooperate in speaking in a particular way; or may just be flustered by the situation and unable to respond. So the different types of people interacting with a hearing impaired person would be one important consideration.

Another factor would be the *deaf person's characteristics*. Here we get into things like motivation, reading ability, the extent to which you become frustrated when communication breaks down, which is a natural reaction. The deaf person has to cope with a lot of weaknesses of the system. Deaf

people vary a lot in their willingness and ability to do that.

The ***environment in which the system is used*** is an important consideration: Is it a system that is in place where it is noisy (like a restaurant or gas station)? Is it a place where the environment can be controlled, such as a TV studio? Is the person--the entity involved with the system--someone who has a real motivation for using it? It gets back to the hearing person again.

What are the ***alternatives available*** to the system? Before we had TDDs, if speech recognition in its current form had come on the scene, we might be willing to tolerate a lot more than we are willing to tolerate now, given that we have a reliable way for communicating by phone. Relay service offers a certain level of intelligibility and accuracy. We are going to have to consider the introduction of speech recognition technology in that kind of environment. The more we get used to high levels of performance from our human systems and existing technology, the less willing we might be to accept the limitations of the recognizer.

The question of *who is buying* is an important one. This is where I think the current developments and the technologies we have been talking about this week can be very useful. They create a business interest in converting speech into text. Relay service is a multi-million dollar enterprise already, and will be growing. As it does, there will be a business incentive to automate the service to make it more cost-effective. This may encourage more creative speech-to-text technology. Otherwise, we might have depended on the individual deaf person to purchase the system--in which case, the system would have to be a lot cheaper and a lot easier to use than it would have to be in a relay service. Some of the people who have been working on speech recognition for deaf people, such as the people at Bellcore and SRI, have been attempting to look at the relay service as a logical location for implementing speech-to-text and text-to-speech. I hope this will continue, and I think it is promising in light of the things we have talked about this week.

There are many possible forms of expressive communication for use by deaf people when conversing with hearing people. There is the person's own speech; writing or typing text; typing to a speech synthesizer and producing synthetic speech. For deaf people whose speech can't be understood by hearing people, it might in the future be possible to have "speech to speech." In this case the deaf person would speak into the recognizer, which would recognize that speech and then pass it on to a speech synthesizer. The speech synthesizer would re-speak the sentence so it would be intelligible to a hearing person. This is what Jim Glenn alluded to at the end of his talk where he talked about recognizing speech of a deaf person, whose speech is not understandable to hearing people, and then reconverting that into synthetic speech so that it can be understood by the hearing person on the other end.

Synthetic speech is an interesting issue. I haven't had a lot of experience in demonstrating synthetic speech to hard of hearing and deaf people; but the experiences I *have* had indicate that we need to work on how better to demonstrate this technology to people who are hearing impaired. If you demonstrate speech synthesis in a group of hearing and deaf people, what you will often see is the display on the screen and you hear a synthesizer speaking the words. All the hearing people go charging over to it because it is really fun to listen to a speech synthesizer. Meanwhile the deaf people are left out; they are standing there saying, "Well, it's just a display on the screen." When we did a demonstration of Bellcore's system here a couple of months ago, we used two interpreters, one for the synthesizer and one for the person in the demo; but still, people were having trouble understanding when the synthesizer was talking and when the person was talking. Some of the hearing impaired people seeing the demonstration had concerns about the quality of the synthetic speech, whether it sounded natural, and so on. This is an area we need to investigate more carefully and to find out what kinds of characteristics of synthetic speech would be important to deaf users. I would imagine they would be the same as those that are important to hearing users of synthetic speech.

In summary, we need to be thinking about these technologies and about applications we might be able to develop in our own areas, and at the same time ask some realistic questions about their real-world uses.

QUESTION AND ANSWER

Question: I think it is just great about this technology and the handouts that were given out to us. Some of the technology related to going from text to speech is now on the market. That's good; I didn't know that. Now my question: First, I'll ask the interpreter right now, would you understand me if I talk like this and do not sign? The interpreter says no, she would not understand without the signing. So if I was speaking to a computer that was trying to recognize my speech, would that computer be able to recognize my speech? And another example, if I called my mother and my

voice was not accurate would the machine be able to recognize my "hello" and change that into the correct speech "hello," which would be sent to my mother? And then in turn, could she speak and then the message would come back to me? Is that kind of thing possible?

Answer: *If the speech recognizer has been trained to understand your speech, it will recognize your "hello" regardless of how it sounds, as long as you say it the same way time after time. Now, the question is whether the recognizer can understand your speech better than hearing people can. When you're speaking in a sentence the hearing person has an advantage over the computer because the hearing person can understand more from the context of the sentence. By the way, Gloria Carlson, Jared Bernstein's colleague on studies of recognition of deaf speech, came to Gallaudet to collect some samples of our students' speech; so we have a personal interest in that study, too. Their work is aimed at trying to do what you want the computer to do--to recognize your speech and then use a speech synthesizer to produce a more understandable version of your sentence.*

Question [Steve Billotte]: This is unrelated to speech recognition. There is a very common method and the cost has come down, and that is fax [facsimile machines]. Is the community aware of it? Is there an education process that needs to be aware of it, because it is very common in businesses. It is a way to communicate with businesses. I would imagine the prices are down now to the $500 range at the lowest end. I haven't heard a mention of it here or seen it in any of the exhibits.

Answer: *The fax's low-end cost is more or less at the high end of TDDs right now. We have been using fax a lot with this conference because of the international component, and it has really helped us greatly with communication. Fax is used as a TDD in Japan because the written form of Japanese does not lend itself well to keyboarding. It is sold at half price to deaf people, with local governments paying the other half. It is rather slow, and it is a product of necessity there because they can't do what we can with a TDD, which allows for a lot quicker response back and forth for short messages. You can type "yes" and "no" very quickly, for example, rather than having to send a whole message back and forth via fax. But because fax is becoming so common here, I think it is worth looking into, and it could be especially helpful for people with disabilities that don't allow them to use the keyboard. Does anyone among the consumers have any interest in fax?*

Comment [Bill Cutler]: There was a mini fax at the exhibit last night, at the HARC exhibit.

Answer: *Right. There was a small fax-like machine that allowed impressions from the pen to send messages back and forth, and that was selling for about $375.*

Comment [Bill Cutler]: Something like that.

Question [Bob Mills]: I wonder if you would comment about human acceptance of technology. My experience is that some people are very nervous about using things and are slow to use them, even though they would really serve a purpose.

Answer: *I think all of us have had some experience with that. If the technology, again, is in an environment where the user is someone who has a motivation for using it--and here I'm not talking about the hearing impaired person necessarily but the captioner or the relay services operator--you still might have some resistance on the job site, but at least you have a better situation than where you might have the general public having a direct interface to a speech recognition system and responding to synthetic speech. Even I hang up the phone when I hear digitized speech saying, "Hi, this is Bob."*

If, by centrally locating the speech input/output system, we can eliminate the need for the end-user to deal with the technical part of it, the system will have a better chance of success. That's why I'm hopeful about relay service and captioning.

Ross Stuckless mentioned yesterday about the vocabulary of an elementary school teacher being small enough that they might be able to implement something like a Dragon Systems speech recognition board. Here you get into a situation where you could have some real user problems if the teacher was trying to use the system for communication and if the students were having to cope with the errors--elementary school students having to cope with the errors that recognizers make. I would love to see more human factors research on speech technology and hearing impaired people. As the technology gets ready, we will have more information to build into new systems.

Question: **I want to take myself back to 1964 when I visited the World's Fair in New York. There was some technology there called the TV phone. Maybe I'm wrong about the name but there was a [moving] picture with a telephone. You could communicate, with the picture on the phone giving the expression as well as the voice. I wonder if that might be a technology that could be useful to have, like a TV picture showing the person's face for communication. Why aren't we using that kind of technology today?**

Answer: *The early trials of that technology showed AT&T that it wasn't a commercially viable technology at least at that time. We had a little conference on this topic back in May of this year where we brought in scientists who have studied this question. They try to reduce the amount of information that must be sent across the wires so that it could be sent over regular telephone lines in the future. Sign language, and even lipreading to a lesser extent, move so fast that it really has pretty high requirements for data transmission. So they have been trying to work with image processing technology like that used in teleconferencing to make it possible, perhaps in the future, to be able to implement the technology for communication among hearing impaired people.*

Again, here is a situation where you would have to have a terminal at both ends of the conversation. To be able to see the face of the hearing impaired person's father or sister or friend, there would have to be a terminal in the other person's home. It could also be implemented, perhaps at a higher cost, in relay service. If we had people who were skilled in communicating with hearing impaired people as relay operators, they could [carry on] an interpreting function for hearing impaired people.

There is a lot more ongoing study of this application of technology in Europe than there is in the United States. Our program will be involved with a new research project at DuPont Research Institute in Delaware to develop some of the software for this application.

Jared Bernstein, SRI International

APPLICATIONS OF SPEECH RECOGNITION TECHNOLOGY IN REHABILITATION

*Jared Bernstein**

Introduction

Speech recognition engineering produces many things. Beside producing systems and devices, the engineering enterprise produces algorithms, subassemblies, and research. There are, of course, systems like voice typewriters and devices like recognizers or synthesizers, but algorithms like stack decoding or the discrete Fourier transform, and assemblies like signal processing boards, and even research topics like lexical search strategy are real products of speech recognition engineering.

This paper first discusses the component technologies that comprise speech recognition, then discusses some disabilities that speech recognition systems and subsystems can help with, and then lists examples of rehabilitation applications, giving some information about places where such work is being done and references to the related literature.

What Goes On Inside a Speech Recognizer

A device that performs "speech recognition" responds to acoustic signals and produces a representation of the linguistic content of the signal. That is, a signal is detected by the device and the device generates some text--a string of words. Although any given device may not exactly transform the incoming signal into the series of representations shown in Figure 1, the figure suggests some intermediate forms that might be estimated on the way to text construction from speech.

Speech recognition itself can be used to overcome disability in environmental control and in text generation, but the key idea in this paper is to show how information tapped from intermediate stages in the complete recognition process can be used to ameliorate disability in circumstances where speech recognition is not yet adequate.

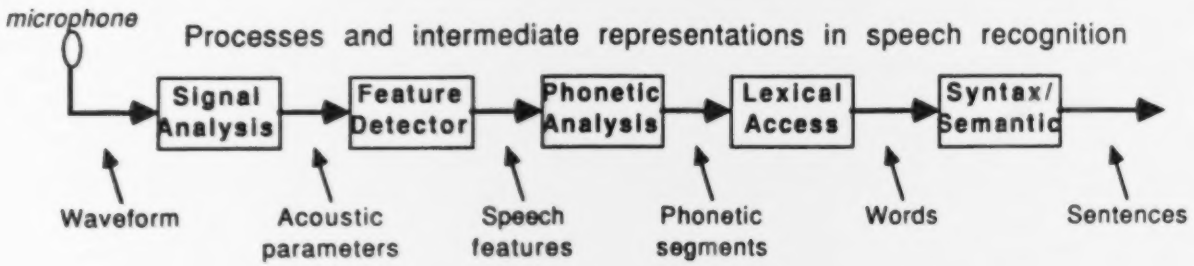


FIGURE 1

*Jared Bernstein, Ph.D., Staff Scientist, Speech Research Program, SRI International, Menlo Park, CA 94025

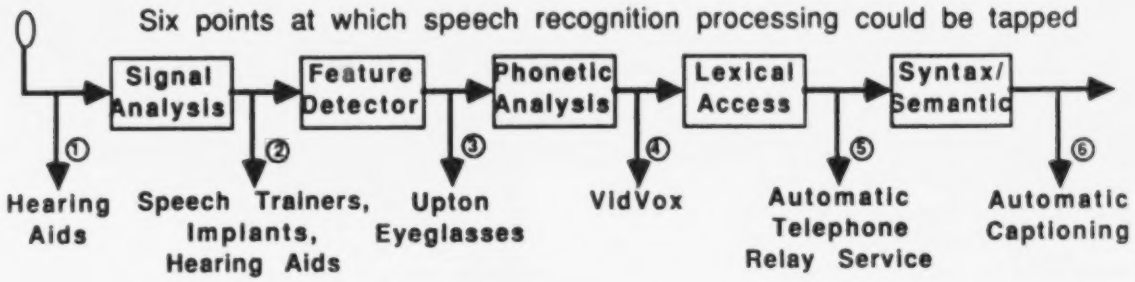


FIGURE 2

Figure 2 illustrates that sensory aids for deaf persons have used displays based on almost every intermediate stage of speech recognition. The various displays named in Figure 2 are discussed below. Other systems that aid disabled persons can also be seen to utilize algorithms and processes of speech recognition independent of the strict serial arrangement of Figure 2.

Disabilities That Speech Recognition Technologies Can Help

Disabilities that speech recognition technology can help include deafness, blindness, motor impairment, and inability to speak. There are also special needs occasioned by common combinations of these, e.g., deaf/blind, deaf/nonvocal, and severe cerebral palsy (motor/nonvocal), among others. We will review research that has been reported in the recent literature with applications primarily to deafness, motor impairment, and inability to speak understandably.

Deafness

Hearing impaired people have varying amounts of difficulty understanding speech, even with hearing aids and a clear view of the speaker's face. Hearing impaired people are the group for which the largest number of speech recognition-based assistive systems have been designed. Typically, a speech reception aid for a hearing impaired person transforms an acoustic signal into some other modality, such as vision or touch, although the most common speech reception aid is a hearing aid, which normally just amplifies the sound and presents it to the ear canal. (For severely hearing impaired individuals, it seems that a hearing aid sometimes just functions as a vibro-tactile stimulator, which can be a considerable help in speechreading.)

An accurate running display of what is being said is "verbatim captioning," and would probably be a very desirable automatic function for those hearing impaired persons with adequate reading skills. However, speech recognition, as available in the next several years, will not provide an error-free orthographic transcription of the continuous speech of any arbitrary person. The question then becomes: For what special sets of circumstances can hearing impaired people get useful information from recognition technologies? The intermediate data streams potentially available from speech recognition become less reliable but more easily readable (if reliable) as you progress to the right in Figure 2. It turns out that almost every possible tap point in speech recognition has been tried in a speech reception aid for hearing impaired people.

Motor Impairment

People with severe motor impairments have difficulties with basic self-care activities like eating, getting to the bathroom, dialing a telephone, controlling lights and appliances, or holding a book and turning the pages. Many such people have suffered spinal cord injuries that leave them without the use of their hands but with clear, ordinary speech. Speech allows them to generate many distinct acoustic signals that can be translated (via speech recognition) into control signals for various electrical and mechanical switches. This is the oldest and best established application of speech recognition in rehabilitation; voice-operated wheelchairs have been prototyped since the mid-1970s, and several voice-operated environmental control systems are on the market.

Nonvocal

Some people do not have intelligible speech. This is the circumstance of some persons with cerebral palsy and some persons who are hearing impaired from an early age; their speech is only intelligible to their families and close associates. Recent research by Carlson, Bernstein, and Bell (1986) has shown that the speech of many of these people, too, may be distinct enough to be recognized by a machine. For the person with limited use of hands and feet, voice can be used to control the environment and generate text (in letters, reports, etc.). For motor impaired or deaf people whose speech is only marginally intelligible to most people, the generated text can then (in principle) be converted into intelligible speech using a text-to-speech synthesizer.

Rehabilitation Applications for Speech Recognition Systems and Subsystems

The following research projects deal with sensory aids for hearing impaired people. There is an excellent book of collected papers entitled, "Sensory Aids for the Hearing Impaired," edited by Levitt, Pickett and Houde (1980), and an issue of the *Journal of Rehabilitation Research and Development* (January 1986) is devoted to articles that review several approaches to supplementing or replacing hearing.

The six examples listed below each tap the speech recognition process at a different point. At each of the six taps, a description is given of at least one rehabilitation application.

Tap the Signal

Speech recognition, broadcast engineering, and teleconferencing have promoted considerable research on noise cancelling, automatic gain control and on the localization and tracking of sound sources. These developments in signal manipulation (close to the microphone) should find application in hearing aid and cochlear implant design as the microphone and source tracking technology becomes more widely available (e.g., Flanagan & Kubli, U.S. Patent #4,555,598). The use of enhanced signals in laboratory hearing aids is reviewed by Braida (1984) and by several authors in Pickett (1977).

Tap the Acoustic Parameters

Acoustic parameters that are commonly calculated from signals without reference to any model of speech include amplitude, periodicity, zero crossing rate, and Fourier spectrum shape. The most developed use for these signals is in devices for training and/or maintaining speech skills in hearing impaired people. Nickerson and Stevens (1973) give a particularly clear presentation of a research project that attempted to train and monitor the progress of students using visual representations of acoustic parameters. A flexible display with memory is available that allows students to see patterns of amplitude or fundamental frequency over time as produced by the teacher or by the students themselves on a previous occasion. Several such displays are available as well as voice-operated games designed to exercise conscious control of voice properties.

Many of the best papers on speech training for deaf persons are reprinted in Levitt et al. (1980, pages 349-424). More recent reports include Pickett and Trybus (1983) and Bernstein et al. (1986).

Tap Phonetic Features

Phonetic features could be understood to be acoustic features that are chosen or scaled with the particular purpose of differentiating speech sounds. For example, the ratio of zero crossing rates in two frequency bands (one high and the other low) can be used to track the presence of a fricative sound such as /s, sh, z, zh/. An ingenious application of phonetic feature tracking is embodied in the Upton eyeglasses, which were developed almost 20 years ago by Hubert W. Upton, a hearing impaired electronics engineer at Bell Helicopter in Texas. A small analog processor about the size of a pack of cigarettes and worn in a pocket or on the belt transforms a microphone signal into a series of signals that actuate one or more lights in a light emitting diode (LED). The lights correspond to various phonetic features that are in the speech signal. For instance, one light pattern signals the presence of the feature "voicing," another signals fricatives, and another signals stops, etc. In the first design the LEDs were attached directly on the surface of an eyeglass lens, but were later moved to a small unit on the temple of the glasses frame and seen by the wearer as reflected in a tiny mirror embedded in

the eyeglass. The mirror is designed so that the lights are in focus for the viewer about a meter out, just where one's interlocutor typically stands. Thus, in the ideal circumstance, the hearing impaired user listens with amplification and speechreads with the help of a pattern of lights that appear to be suspended in the air just in front of the speaker's face. Upton has been wearing a pair every day for the last 20 years, and several other people have tried them, too.

Research results show a real improvement in speechreading with the Upton eyeglasses, but when they were tested at Gallaudet in the 1970s there were problems maintaining the units, and none of the experimental subjects went on to use the device. I have worn Upton's pair for a few minutes, and I am convinced that the Upton eyeglasses can be useful for hearing impaired people. Beside the two papers on Upton eyeglasses in the volume edited by Levitt et al. (1980, pages 322-28), there are patents, and a review of the whole development and testing by Pickett et al. (1976).

The autocuer project at Gallaudet and at RTI in North Carolina (Cornett et al., 1977) aimed to produce a prototype of a device very similar to Upton's but using LED patterns that corresponded to the logic of cued speech (Cornett, 1967). The primary differences cited by Cornett seem to be that the cued speech symbol set was more complementary to the information that could be read from the lips and that the cues in the autocuer were to change at a slower rate, corresponding to events that span more than one acoustic segment. That I know of, no wearable prototype autocuer has been produced. Another related speech reception aid is described by Erber (1979) and Erber et al. (1979).

Tap Segments

Phonetic analysis of a continuous speech signal aims to identify cohesive intervals of the signal in which certain phonetic features are stable. These acoustic segments of the speech signal may correspond in time to articulatory gestures that linguists identify with phonemes, but they are conceptually independent of any particular linguistic analysis. A segment might, for example, be a 100 millisecond interval of periodic signal with slowly changing spectral peaks at about 300 Hz and 2300 Hz, bounded on either side by non-periodic intervals. This segment might be identified by a machine as the vowel /i/, or at least as a high front vowel /i, I, or ey/. The VidVox project (Russell, 1986) was initiated at the Sensory Aids Foundation in the belief that useful automatic captioning (i.e., accurate real-time text automatically generated from natural speech signals) was a long way in the future, but that real-time display of phonetic sequences might be possible sooner. Further, it was assumed that hearing impaired people viewing a fairly accurate phonetic transcription of speech rolling past on a "Times Square" display would be able to outperform an automatic system in the lexical access and syntax/semantics processing (the last two processes in Figure 1). The research was contracted to Bolt, Beranek, and Newman (BBN) in Cambridge, Massachusetts. The speech recognition group at BBN did an excellent job of optimizing recognition performance at the segment tap point, and produced transcriptions for one speaker that were about 80% accurate--the highest ever recorded. However, human factors research on the VidVox concept found that people reading transcriptions could tolerate some errors and that people could read transcriptions slowly when word boundaries were not indicated, but the combination of no word boundaries, and even 5% errors, made reading just about impossible. The project is currently in abeyance, waiting for further funding.

Tap Words

Only at the point where a recognizer starts to judge how well words match to portions of the incoming speech signal is the tapped output directly accessible to ordinary people. However, two problems prevent this tap point from being the obvious place to start. First, for the common continuous speech we use, there aren't discernible breaks between words, so without the further knowledge resource identified in Figure 1 as "Syntax/Semantics" how can a machine know that:

"Paula mastodon credit"
should be
"Paul amassed it on credit."

Secondly, even if people spoke with pauses between words and "here-hear" homophony were no problem, speech recognition devices are not very accurate for the 20,000-word vocabulary that might be needed to provide general coverage of a typical range of conversation, news, warnings, etc. At perhaps 50% accuracy in the very large vocabulary case, most current speech recognition devices are not ready for commercial trial. However, some circumstances may make them useful to hearing impaired people.

SRI International has been working for several years

on an automatic telephone relay service (Bernstein et al., 1984, Carlson and Bernstein, 1988). A telephone relay service allows a hearing impaired person to use a TDD keyboard/display to "talk" to any hearing person over the regular phone lines. The hearing impaired person communicates with a relay operator, who has a TDD and who interacts by voice with others over the phone; the relay operator then translates back through the TDD to the hearing impaired person what the person on the voice channel has said. SRI is working on automating this process to make it cheaper and provide greater privacy. A hearing user speaks one word at a time, the speech recognition system generates its best guesses as to what each word is, and the hearing impaired person sees the word choices displayed on a screen. The hearing impaired person then needs to use human intelligence to find a reasonable path through the word choices to make a meaningful sentence.

Several things need to be true for an automatic relay service to be possible: In the hearing-to-deaf direction, the hearing person needs to be able to speak in separated words; the recognizer needs to be accurate enough to display an adequate representation of the word sequence so that it can be figured out; and hearing impaired people must be able to make sense out of this representation. SRI's studies indicate that all of these conditions are currently met or within reach in the near term. In the direction from the hearing impaired person to the hearing person, there are only requirements if the hearing impaired person does not have understandable speech. In that case, the text-to-speech converter needs to be intelligible, and it would be helpful if the hearing impaired person could enter text in a fast, convenient way. Commercial text-to-speech converters are now quite intelligible (at first hearing, and even over the phone) though no text entry system has been designed that will allow a typical person to enter text at even half of an ordinary conversational rate of about 150 words per minute.

Tap Sentences

The ultimate device for many situations in which hearing impaired people need assistance is accurate, automatic, real-time captioning into normal text. This capability is coming sometime around the turn of the next century; the first claims to this performance are emerging now, and I would think that "science fiction"-level speech recognition will be a regular thing by 2010, if not before. One important datum to note in the meantime is that relatively simple models of the grammatical constraints to be found in a sentence can reduce the word error rate of current recognition systems by two-thirds or more. That is, tapping at the sentence level instead of the word level can reduce the word error rate from one error in five words to one error in 20 words (Bahl et al., 1984).

Other Applications

The following is a brief listing of selected other rehabilitation applications of speech recognition technologies, grouped by function and listed mostly as they are described in the literature. Few, if any, of these systems are products, and most are not even in the prototype stage. Most are partial devices and/or simulations that have been built and tested on a few subjects. References are generally to more recent research projects and are not exhaustive.

Environmental Control

Environmental and mobility control by voice for people with limited motor control is probably the most developed application for speech recognition related to disability. There are a growing number of products available with names like "MasterVoice" or "Butler in a Box" that provide a voice recognition interface between a user and commercial device that can control the operation of various functions in a person's living space. A closely related, but less generally successful, application is the control of a power wheelchair or the remote control of a mobile robot by voice command. Voice-controlled wheelchairs and a voice-controlled remote mobile manipulator are under development at the Rehabilitation Engineering Research and Development Center at the Palo Alto Veterans Administration Hospital in conjunction with Stanford University (Michalowski, Leifer, and Van der Loos, 1986).

Speech Prosthesis (Voice In/Out Communication Aid)

There has been a great deal of work on communication aids for speech impaired people. Much of this work has focused on the problem of efficient, reliable message entry. Several investigators have recently begun trying speech recognition for message input to communication aids to increase message entry rate and avoid mechanical interface problems (Barker and Hastings, 1983; Fried-Oken, 1984; Rodman et al., 1984; Stevens and Bernstein, 1985; Ahmad, 1985). Wearing a head-mounted microphone can leave the subjects' hands and eyes free, reducing the potential for mechanical failure that is more common with a keyboard or other electromechanical switch. These

investigators have found several speech impaired subjects to be successful using a speech recognition interface. Results for a larger sample of speech impaired subjects are reported by Carlson and Bernstein in this volume.

For speech recognition to be successful in the application of communication aids, the speech does not have to be spoken correctly, but must be spoken consistently and distinctly. If each word is said the same way every time it is spoken, and each word is distinct from every other word in the vocabulary, then a speech recognizer can match the speech to stored templates.

Cross-Modality Captioning

Cross-modality captioning is the adaptation of tap point captioning to the needs of people who have difficulty reading printed text--for example, low-vision and blind people and hearing impaired people with limited reading skills. For a deaf-blind person, the captioning text could be translated into Braille and displayed on a dynamic display or (possibly in the future) translated into sign and fingerspelling and displayed synthetically on video screens or on mechanical hands, such as the one developed at the Smith-Kettlewell Research Foundation (Gilden and Jaffe, 1986).

Text Generation

High speed text generation has several applications for disabled people. Many hearing impaired people now follow sports and news broadcasts with the help of real-time captioning. Several investigators (Minneman, 1985; Ross, 1986) have designed systems that facilitate text generation from that most common keyboard, the push button telephone. Beyond that, there has been considerable effort at many sites to increase the rate of text generation for people with very limited motor control. Real-time captioning uses a steno keyboard, which shares with the telephone keyboard a running underspecification of the text. The same knowledge of the structure of sentences and words that is being gathered for use in commercial recognition systems can be used (and is being used) to unpack ambiguous input. The most elaborate efforts in this field involve anticipating text systems for people who can only manage a few controlled movements per minute. These have been developed in many forms, and are reviewed by Vanderheiden (1984).

References

Ahmad, W. (1985). Computer recognition of cerebral palsy speech using non-linear mapping. Ph.D. Thesis, University of Southern California, Department of Computer Science.

Bahl, L. & Picheny, M. (1984). Some experiments with large-vocabulary isolated-word sentence recognition. *Proceedings IEEE ICASSP-84*, p. 26.5.1.

Barker, M. & Hastings, W. (1983). Access to computers by severely disabled people. Final report to U.S. Department of Education, NIHR, Grant G008005817.

Bernstein, J., Becker, R., Bell, D., Murveit, H., Poza, F., & Stevens, G. (1984). Telephone communication between deaf and hearing persons. *Proceedings IEEE ICASSP-84*, p. 26.7.1.

Bernstein, L., Ferguson, J., & Goldstein, M. (1986). Speech training devices for profoundly deaf children. *IEEE ICASSP-86*, Tokyo, pp. 633-636.

Braida, L. (1984). Speech processing for the hearing impaired. *Proceedings of the Second International Conference on Rehabilitation Engineering, Special Session Volume*, pp. 146-149.

Carlson, G. & Bernstein, J. (1988). Automatic speech recognition of impaired speech. Article for *International Journal of Rehabilitation Research*.

Carlson, G. & Bernstein, J. (1986). A system for telephone communication between hearing impaired and hearing people. *Volta Review*, *88*(7), p. 367.

Carlson, G., Bernstein, J., & Bell, D. (1986). Machine recognition of impaired speech for telecommunication. *Proceedings AVIOS '86 Voice I/O Systems Applications Conference*, pp. 563-577.

Cornett, R. (1967). Cued speech. *American Annals of the Deaf, 112*.

Cornett, R., Beadles, R., & Wilson, B. (1977, May). Automatic cued speech. In J. Pickett (Ed.), *Papers from the Research Conference on Speech-Processing Aids for the Deaf*, Gallaudet Research Institute, Washington, D.C., pp. 224-239.

Erber, N. (1979). Real-time synthesis of optical mouth shapes from vowel sounds. *Journal of the Acoustical Society of America, 66*, pp. 1542-1544.

Erber, N., Sachs, R., & DeFilippo, C. (1979). Optical synthesis of articulatory images for lipreading evaluation and instruction. In D.L. McPherson (Ed.), *Advances in Prosthetics Devices for the Deaf: A Technical Workshop*, Rochester, NY: NTID.

Fried-Oken, M. (1984). The voice recognition device for computer control by motorically- and speech impaired individuals. *Proceedings of the Second International Conference on Rehabilitation Engineering*.

Gilden, D. & Jaffe, D. (1986). Dexter--a helping hand for communicating with the deaf-blind. *Proceedings of RESNA '86*. Minneapolis, Minnesota.

Levitt, H., Pickett, J., & Houde, R. (Eds.) (1980). *Sensory Aids for the Hearing Impaired*. IEEE Press.

Levitt, H. (Guest Editor). (1986). *Journal of Rehabilitation Research and Development*, 23 (1).
Michalowski, S., Leifer, L., & Van der Loos, H. (1986). Computer configuration for a robotic manipulation aid. *Proceedings RESNA '86*. Minneapolis, Minnesota.

Minneman, S. (1985). A simplified touch-tone telecommunication aid for deaf and hearing impaired individuals. *Proceedings, RESNA 8th Annual Conference*. Memphis, Tennessee.

Nickerson, R. & Stevens, K. (1973). Teaching speech to the deaf, can a computer help? *IEEE Trans. Audio and Electroacoustics*. Also reprinted in Levitt et al. (1980).

Pickett, J. (Ed.) (1977). *Papers from the Research Conference on Speech-Processing Aids for the Deaf*. Gallaudet Research Institute, Washington, DC.

Pickett, J. & Trybus, R. (1983). The Gallaudet Rehabilitation Engineering Center for the Deaf and Hearing Impaired. *Proceedings, RESNA '83, Sixth Annual Conference on Rehabilitation Engineering*. San Diego, CA.

Pickett, J., Gengel, R., & Quinn, R. (1976). Research with the Upton eyeglass speechreader. In G. Fant (Ed.), *Speech Communication, 4*. New York: Wiley. Also reprinted in Levitt et al. (1980).

Ross, W. (1986). Annual report to NIH, Contract N01-NS-5-2392. SRI International.

Russell, Y. (1986). Final report on a feasibility model for a speech recognition communication aid for deaf persons. *Proceedings, RESNA '86*, Minneapolis, Minnesota.

Rodman, R., Moody, T., & Price, J. (1984). Speech recognizer performance of voice handicapped users. *Proceedings AVIOS '84 Conference*.

Stevens, G. & Bernstein, J. (1985). Machine recognition and intelligibility of deaf speech. *Proceedings of the RESNA Eighth Conference*. Memphis, TN.

Vanderheiden, G. (1984). Augmentative communication: Trends and priorities in research and delivery. *Proceedings of the Second International Conference of Rehabilitation Engineering*. Ottawa, Canada.

Representatives of consumer organizations, businesses, government, education, and rehabilitation agencies attended the conference.

AUTOMATIC SPEECH RECOGNITION OF IMPAIRED SPEECH

Gloria Stevens Carlson
Jared Bernstein[*]

[Editors' Note: This paper was accepted for publication in the International Journal of Rehabilitation Research. *The research was supported in part by NIH Contract N01-NS-5-2394.]*

Problem and Objectives

Many speech impaired individuals have speech that is partially intelligible to people who converse with them regularly, but that is virtually unintelligible to unfamiliar listeners. For such people, if an automatic speech recognizer could "understand" the unintelligible speech, then it could be used to recode the speech as intelligible synthetic speech or as a printed display. This process could be faster and easier than typing. A speaker dependent speech recognizer would be appropriate for this task because it does not require that messages be spoken according to standard English pronunciation; instead, it requires only that users speak sufficiently consistently and distinctly so that their speech can be matched to pretrained utterances.

SRI's objectives were twofold: to determine for several categories of speech impaired individuals whether automatic speech recognition was feasible, and to develop and evaluate a laboratory voice-input system with several speech impaired users.

Methods and Results

For over two years SRI has been studying automatic speech recognition of impaired speech. We recorded the speech of 81 speech impaired people (primarily persons with hearing impairments or cerebral palsy) reading a 300-word vocabulary six times (three times through to train the device and three times through one week later to test it) and then a 65-word story at the end of the second session. This speech was input to a high performance, template-based speech recognizer, and the results were analyzed to determine the percentage of correctly recognized words for the entire 300-word vocabulary and for smaller subsets of the vocabulary.

We also played sample recordings to normal hearing listeners who were unfamiliar with the talkers so that we could compare human intelligibility with machine accuracy. Although machine and listener recognition accuracy varied greatly across speakers, the speech of approximately 25% of the impaired speakers was better recognized by machine than by human listeners with a 300-word vocabulary spoken in context. Fifty-seven percent of the impaired speakers were better recognized by machine than by human listeners with a 50-word vocabulary spoken in context. This work is described in detail elsewhere (Carlson et al., 1986; Carlson and Bernstein, 1988).

Because our findings suggested that some speech impaired individuals might benefit from speech recognition technology, we developed and evaluated a laboratory voice-input system. The system offers interactive voice-in and voice-out capability with immediate feedback to the user about whether each word is recognized correctly. The user moves a "mouse" to correct the machine's errors (i.e., to select

[*]Gloria Stevens Carlson and Jared Bernstein, Ph.D., Speech Research Program, SRI International, 333 Ravenswood Avenue, Menlo Park, CA 94025

a word other than that with the highest recognition score) and send messages to the text-to-speech synthesizer.

To determine whether people could use the speech recognition interface in interactions with the computer, and whether, in fact, speech input was faster and more accurate than typing input for some users, we invited twelve subjects to try the laboratory speech system. The subjects were limited to a 50-word vocabulary when speaking a short paragraph. After only a few minutes practice, five of the twelve speakers produced the same text faster using speech input than by typing.

Two subjects (one hearing impaired and one with cerebral palsy), who were not immediately faster with speech input, were asked to return to practice using the machine more extensively. Both subjects type regularly, yet, after one month of practicing for two hours a week (nine hours total), both subjects improved dramatically with the speech recognizer. The hearing impaired subject was generally faster than the cerebral palsy subject with either typing or speech recognition, as expected, given the motor impairment associated with cerebral palsy. The hearing impaired person's speaking rate was somewhat better than her typing rate (40 words per minute speaking versus 31 words per minute typing) after one month, whereas the speech rate of the person with cerebral palsy nearly doubled his typing rate (20 words per minute speaking versus twelve words per minute typing). With more practice, both subjects would likely improve even more. The cerebral palsy subject, in particular, could benefit from speech recognition technology for text input. Development and evaluation of this laboratory system are described in greater detail in Carlson (1988).

Discussion

Even though hearing impaired people are generally faster and more accurate with the speech recognizer than are people with cerebral palsy, speech recognition technology may offer greater promise for cerebral palsy people than for hearing impaired people, given the likely uses of speech recognition devices by the two populations. Many people with cerebral palsy have significant difficulty manipulating their environment, whether that involves picking up the phone, unlocking the door, or generating text. Even if their speech is recognized somewhat less accurately, on average, than is the speech of hearing impaired people, alternative modalities, like keyboard entry and handwriting, are relatively much more problematic for them. Therefore, lower levels of recognition performance can yield a comparative advantage over alternative modalities. With a more flexible voice input interface, used by people with more practice, the relative advantage of automatic speech recognition may be even greater for some people with cerebral palsy.

For example, the hearing impaired person described above was better "understood" by machine than by listeners (80% versus 57%), but she can type almost as quickly, and with a much larger vocabulary, as she can produce text with the speech recognizer. She might benefit from a speech output device to improve her intelligibility, but not necessarily from one driven by speech input. On the other hand, the person with cerebral palsy, who is somewhat better understood by listeners than by machine (77% versus 73%[1]), could benefit from a speech input system for communication or for interaction with computers since his speech rate is much faster than his typing. He is a computer programmer, so this would be particularly useful.

Moreover, this study was performed using a recognizer that was not modified for each individual speaker. Recognition accuracy and vocabulary size might be substantially large with appropriate modification to the recognition algorithms, but such modifications were beyond the scope of this study. With further development of an appropriate human interface, automatic speech recognition may improve text generation for some speech impaired individuals, in particular those with cerebral palsy, so that they can more easily manipulate their environment or more easily communicate with other people.

References

Carlson, G.S. (1988). Development of a voice-input system for speech-impaired people. *Proceedings AVIOS '88 Voice I/O Systems Applications Conference.*

Carlson, G.S. & Bernstein, J. (1988). A voice-input communication aid. *Final Report to National Institute of Neurological and Communicative Disorders and Stroke, National Institutes of Health.* (Contract N01-NS-5-2394).

Carlson, G.S., Bernstein, J., & Bell, D. (1986). Machine recognition of impaired speech for telecommunication. *Proceedings AVIOS '86 Voice I/O Systems Applications Conference*, pp. 563-577.

Murveit, H. & Broderson, R. (1986). An integrated-circuit-based speech recognition system. *IEEE Transactions on Acoustics, Speech, and Signal Processing, AASP-34* (6), pp. 1465-1472.

Notes

1. The percentage of correct recognition in these cases is with a 50-word vocabulary in citation form.

Steven DeGennaro, Thomas J. Watson Research Center

MORE QUESTIONS AND ANSWERS ON AUTOMATIC SPEECH RECOGNITION

For some of the conference topics, leaders in the field spoke but papers were not written. Included here are questions and answers following presentations by several of these speakers.

Steven DeGennaro, Sc.D.
Research Scientist
Thomas J. Watson Research Center

[Editors' Note: Dr. DeGennaro spoke about the Tangora speech recognition system.]

Question: What are the odds of developing artificial intelligence on an equal basis to that of a human being?

Answer: *Groups other than our group are working in this area. None of them has demonstrated a system with this level of performance. But again, this system has nowhere near the level of performance of the human being.*

Question: It's a good thing that you are working to put that into a personal computer, but are you also using larger machines that are available, and perhaps parallel machines?

Answer: *We are working in both areas. Half of our group is now working on a continuous speech version of this system, which runs on the largest IBM mainframe, with six processors. The algorithms are not quite at the point where we want to reduce it to this kind of hardware, but we have another group of people worrying about parallel processing. When the algorithms have been developed properly, we will develop more hardware.*

Question: For deaf people, would the machines be able to recognize deaf speech?

Answer: *I haven't tried it. This system [Tangora] depends on your producing the same phone, independent of context, in a consistent manner. The systems that are word-based depend on you saying the entire word consistently. But because we don't make you train by saying each word, the consistent pronunciation of words is not enough. It has to be a consistent pronunciation of phones. We have had people with very, very heavy accents that the system works for. Our senior analyst is Czechoslovakian, and he has a heavy accent, and this system works for him.*

John Scarcella
Regional Sales Manager
Kurzweil Applied Intelligence

[Editors' Note: Mr. Scarcella demonstrated the Kurzweil VoiceWorks, a commercially available speech-to-text system. The questions and answers are tied to the demonstration and there is, unfortunately, no way of presenting the demonstration in the Proceedings. Despite this limitation, we are including the questions because the content of the replies gives useful information about speech recognition systems.]

Question: Is my impression correct that you are changing the tone of your voice when you don't want [the system] to listen to you? [Scarcella: Your question is, why was the system able to recognize me for certain things and not other things, even though the microphone was not being turned on or off while I was speaking?] Right.

Answer: *It could be for one of three reasons. First, it could be because I could be speaking continuously, and the system is looking for discrete speech with a pause between each word or phrase. Number two, I could be speaking discretely, but saying things that are not in my vocabulary. Or, number three, I may be speaking discretely. I may be saying things that are in my vocabulary, but they may not be valid in where I am in my application dependent on how I*

have set up the system in the beginning. In this case, it was because I was speaking continuously.

The point about tonal inflection: Everyone tells me, "You talk differently when you speak to the computer versus when you talk to an audience." Well, that's true. I speak discretely to the computer, but I also lapse into a kind of monotonous tone of voice. To show you that doesn't make any real difference, I will change my voice. [Demonstration of speech recognition with changing tonal inflection.] Believe me, when I go home, I don't talk that way to my wife.

Question: How does that medical system deal with ambiguity of words like, "Mr. Wright is on your right side."

Answer: *In the medical application, we set the vocabulary into a structured reporting mode. It will only recognize vocabulary that is "active" in the area of the report you are using. However, that mode is not used for free-form text dictation.*

Question: You said when we have a more powerful processor like the 486, you will have continuous speech recognition. Is this working in the lab now?

Answer: *We are working on continuous speech. We are also working on reducing the training time. This system currently requires you to train all the words. You have a 5,000-word vocabulary; you have to train them all.*

We have a software utility that allows you to take copies of your current documents [letters, reports, etc.], feed them in by floppy disk or scan your current documents, and come up with a list of words from your own documents. Then you can rate them as to frequency of usage. You may only want 90% of the most frequent 2,000 words, and add others as you go. You can add words as you go. The system would pull the new word out of my document, ask me to type it, speak it, and then go back to my document and use it.

GLOSSARY

[Editors' Note: When new technologies and services are introduced into any field, there is a period in which many different terms are used for the same concept. The connotations of these various terms can provoke much debate. The purpose of this glossary is to give the current working definitions of many terms used in the conference and to aid the reader in understanding the content of the conference papers. However, the reader should note that the terminology is evolving and this glossary could quickly become outdated.]

Because the use of these terms depends on context, we have identified in each case the technology to which it refers in this glossary:

ASR = automatic speech recognition
RTC = real-time captioning
TRS = telephone relay service

Adaptation* [ASR]--The automatic modification of existing internal machine representations (e.g., template sets, word models, etc.) of specific utterances and/or noise.

American Sign Language/ASL [TRS]--The predominant sign language used by deaf people in the United States and Canada. Its grammatical structure differs radically from the grammatical structure of English.

Articulation [ASR]--Movement of the speech articulators (tongue, lips, teeth) to produce specific speech sounds.

ASCII [TRS, RTC, ASR]--American Standard Code for Information Interchange. This is the standard computer code used in the United States. It has eight bits per character.

Baudot [TRS, RTC]--The name of the electronic code used by TDDs in the United States. It has five bits per character and transmits at 45.45 bits per second.

Blockage [TRS]--An unsuccessful call because of busy telephone lines. Blockage rate refers to the percentage of attempted calls that are unsuccessful (i.e., that encounter a busy signal).

Call Volume [TRS]--Number of calls placed through a relay service during a particular period of time.

Capped Surcharge [TRS]--Surcharge provision in which a limitation is set, usually by the state legislature, on the amount that can be charged to telephone subscribers each month.

Captioner/Captionist [RTC]--Person who prepares captions for video material.

Captions [RTC]--Subtitles; written representations of a video program's dialogue. Captions may be open or closed. Open captions are seen on all video screens. Closed captions are seen only on screens equipped with a special electronic decoder.

Chord Keyboards [TRS, RTC]--Specially designed keyboards for inputting text at high speed by using a particular code. The operator presses more than one key at a time to generate a phoneme, word, or phrase.

Coarticulation [ASR]--The overlapping of articulation associated with adjacent sounds.

Communications Assistant [TRS]--Job title given by some organizations for the worker responsible for relaying calls within a relay service.

Computer Aided Transcription [RTC]--A general term referring to creation of transcripts of spoken dialogue with assistance from a computer. Can be either normal keyboard entry or some special input device, such as a stenotype.

Connected Words* [ASR]--Words spoken carefully, but with no explicit pauses between them.

Continuous Speech* [ASR]--Words spoken fluently and rapidly, as in conversational speech.

Decoder [RTC]--The generic name for the electronic device that makes closed captions visible on a screen.

Deletion* [ASR]--An instance in which a spoken word is ignored, and for which the recognizer or system provides no response (e.g., in recognizing a string of digits, if the recognizer returns one less digit than has been input).

Dictionary [RTC]--Table of steno entries and their English equivalents.

Discrete Utterance Recognition* [ASR]--The process of recognizing a word or several words spoken as a single entry.

Divestiture [TRS]--Term used to identify the break-up of the Bell System. Refers to AT&T having been divested of various components of its operations.

Dual Party Relay Service [TRS]--Describes relay services in which both parties are on the line at the same time, and in which an operator speaks the typed message of the deaf person and types the spoken message of the hearing person. This term distinguishes such relayed calls from message relay service, in which the message is relayed in one direction only, and not while both parties are on the line.

Encoder [RTC]--Generic name for the electronic device which encodes closed captions on a video program.

Enrollment* [ASR]--The process of constructing representations of speech, such as template sets or word models, to be used by a recognizer. Also referred to as "system training," as distinct from "user training."

False Acceptance* [ASR]--An example of failure to reject properly spoken input utterances that are not part of the active vocabulary, resulting in selection of a word in the active vocabulary.

FCC/Federal Communications Commission [TRS]--Federal agency whose regulatory authority over communications includes interstate telephone communications.

Grammar* [ASR]--In general, a grammar of a language is a scheme for specifying the sentences allowed in the language, indicating the rules for combining words into phrases and clauses. In automatic speech recognition, task grammars specify the active vocabularies and transition rules that define the sets of valid statements to complete the tasks. The task grammar and structured vocabulary provide syntactic control of the speech recognition process that can greatly enhance performance.

Insertion* [ASR]--An instance of a recognition occurring due to spurious noise or an utterance other than those that are legitimate on syntactic considerations. In the former case, some input other than an utterance (typically some ambient or electrical noise artifact) is not properly rejected and the system response indicates that some utterance in the recognition vocabulary occurred. In the latter case, a word that has been uttered (but which is not part of the active recognition vocabulary because of current syntactic constraints) is falsely accepted as an utterance from the active recognition vocabulary.

Insta Cap [RTC]--A simple captioning system developed by the Canadian Captioning Development Agency (CCDA). It uses an ordinary personal computer and keyboard, and is designed for use in meetings where interpreters are not available and note writing is too slow.

Insta Text [RTC]--First real-time captioning system. The system was built by Translation Systems, Inc. under contract with the National Captioning Institute.

Interexchange Carriers [TRS]--Long distance telephone companies.

Isolated Words* [ASR]--Words spoken with pauses (typically with duration in excess of 200 ms) before and after each word.

Isolated Word Recognition* [ASR]--See "discrete utterance recognition."

Lag Time [RTC]--The period of time between when a word is spoken on a video program and when the caption of that word appears on the screen. This is usually associated with real-time captioning situations where a stenographer is creating captions as a program is aired.

Large Print Interpreting [RTC]--Refers to interpreting with a real-time captioning system which produces large print on a screen. The term can refer either to systems used for large groups or to special systems for the benefit of visually impaired deaf people.

Line 21 [RTC]--In the United States, television pictures are composed of 525 rows of electronic dots. The first few and last few rows are not used for actual picture transmission. They are the familiar black bar seen on television screens which need adjustment. Line 21 is the 21st row from the top of the television picture, the last line of the black bar. Line 21 is used for sending coded captions which can be read by a decoder.

Local Exchange Carriers [TRS]--Local telephone companies.

Message Relay Associate [TRS]--Job title used by some organizations for the worker responsible for relaying calls within a relay service.

Message Relay Service, Message Relay [TRS]--This term is used in two ways. In the strict sense, message relay is a service in which messages are passed on to the other party (to the hearing person, if the caller is deaf). The message is not delivered while the calling party is on the line. It is a one-way service. The term "message relay" is often also used as a synonym for "relay service," although this use is incorrect.

Message Transfer Associate [TRS]--Job title used by some organizations for the worker responsible for relaying calls within a relay service.

Ms [RTC]--milliseconds.

Natural Language* [ASR]--Syntactically unconstrained word sequences, typically drawn from a large lexicon and complying with conventional usage.

Notice of Inquiry [TRS]--Proceeding of the FCC in which a notice is sent to all interested parties about the FCC's intent to study a particular issue. A Notice of Inquiry [NOI] invites comment and specifies a deadline for comments. Sometimes the study is extended based on the first round of comments. A subsequent proceeding is called a Further Notice of Inquiry.

Operator [TRS]--Job title given by some organizations for the worker responsible for relaying calls within a relay service. See also "TDD operator."

PBX [TRS]--Private branch exchange; a telephone exchange serving an individual organization and having connections to a public telephone exchange.

Public Utilities/Utility Commission (PUC), Public Services Commission (PSC) [TRS]--State-level quasi-governmental body responsible for regulation of public utilities such as telephone, electricity, water, and gas.

Real-Time Captioning [RTC]--The simultaneous creation and transmission of captions for display purposes.

Real-Time Reporter [RTC]--Person who enters the steno code into the real-time captioning system. Also referred to as "captioner."

Recognition Unit* [ASR]--The basic unit of speech on which recognition is being performed, often presumed to be the word. The actual unit used may be smaller (e.g., phones, demisyllables, syllables, or features) or larger (e.g., multi-word phrases or utterances).

Recognition Vocabulary* [ASR]--See "vocabulary."

Rejection* [ASR]--The property of rejecting inputs. There are three general classes of system response involving rejection: i) noise rejection, ii) rejection of improperly spoken input utterances, iii) rejection of properly spoken input utterances that are part of the active vocabulary, sometimes termed false rejection.

Relay Service [TRS]--Generic term for service which permits hearing people to speak with deaf people who communicate via TDD or computer. The caller phones the relay service. While the caller is on the line, a relay service operator places a call to the other party. The operator speaks the hearing impaired person's typed message, and types the hearing person's message.

Speaker Dependent Recognition* [ASR]--A procedure for speech recognition which depends on enrollment data from the individual speaker who is to use the device.

Speaker Independent Recognition* [ASR]--A procedure for speech recognition which requires no previous enrollment data from the individual who is to use the device.

Specialized Customer-Premises Equipment (SCPE) [TRS]--Equipment used by disabled people for access to the telephone. TDDs are examples of SCPE.

State-Mandated Programs [TRS]--Relay services that resulted from action of the state legislature and/or Public Utility Commission.

Station [TRS]--In the context of relay service, refers to the work station of the person responsible for relaying calls.

Stenographer/Stenotypist/Steno Reporter [RTC]--A person trained in the use of stenographic equipment. In the context of captioning, it usually refers to the person who creates real-time captions.

Stenographer's Dictionary [RTC]--A computerized file consisting of words and the phonetic code used to represent these words. Because every stenographer has his or her own particular coding habits each needs to develop a unique stenographic dictionary.

Stenotype [RTC]--The phonetic typing device used by stenographers.

Substitution* [ASR]--An instance in which one word in the recognition vocabulary is incorrectly recognized as another word in the recognition vocabulary.

Superphone [TRS, RTC]--A brand of TDD formerly produced by Weitbrecht Communications. The Superphone was a major component of the TeleBraille, a previous product of Telesensory Systems, Inc.

Surcharge [TRS]--In the context of relay services, generally refers to the practice of adding a few cents to the monthly phone bill of telephone subscribers.

Syntax* [ASR]--Structure by which grammatical word sequences are specified.

System 85 [TRS]--A type of PBX marketed by AT&T.

TDD [TRS]--Telecommunications Device for the Deaf. Generic term used for terminals used for telephone communication by deaf and hard of hearing people. In common use, TDD refers only to those terminals that transmit messages in Baudot code. Computers with modems generally are not referred to as TDDs.

TDD Operator [TRS]--Worker responsible for assisting TDD callers with directory assistance, credit card calling, collect calling, and other operator-assisted calls. (Currently available only at AT&T.)

TDD Relay Service [TRS]--Synonym for relay service.

TeleBraille [RTC, TRS]--A kind of TDD that had Braille output, for use by deaf-blind people.
The TeleBraille was produced by Telesensory Systems, Inc. (There is currently no TeleBraille on the market.)

TeleCaption [RTC]--The brand name of the closed caption television decoder produced by the National Captioning Institute. There have been three models: TeleCaption, TeleCaption II, and TeleCaption 3000. TeleCaption is sold out.

Telecommunications Carriers [TRS]--Telephone companies that supply transmission equipment and services. The term "telecommunications carriers" includes both local exchange carriers and interexchange carriers.

Telecommunications for the Disabled Act of 1982 [TRS]--Act of Congress which, among other things, ordered the FCC to study and consider the needs of disabled people in the implementation of future telecommunications regulation decisions.

Telephone Assistant [TRS]--Job title used by some organizations for the worker responsible for relaying calls within a relay service.

Telephone Relay Service [TRS]--Synonym for relay service.

Teleprompter [RTC]--The screen system which shows the script to be followed by a commentator. The screen is placed off camera where the commentator can see it and read from it during a live program.

Teletext [RTC]--A text information system which sends coded information over the Vertical Blanking Interval (VBI) of a television signal. The technique is similar to the Line 21 closed captioning system, but teletext is a general purpose high-speed information system, and closed caption services are one small feature. Since teletext sends information over the air at a much higher speed than the Line 21 system, the teletext signal is much more fragile and difficult to receive.

Text Telephone [TRS]--Term used in many European countries for a telecommunications device for the deaf. European text telephones use a different

communications protocol from American TDDs, and the two cannot converse unless specially equipped to do so.

Throughput Time [RTC]--Amount of time from the real-time reporter's stroke to the output of the English caption.

Token* [ASR]--A sample speech utterance.

Training* [ASR]--See "enrollment." System training is preferably referred to as enrollment. User training refers to the process of user familiarization with speech technology (e.g., learning how to use an automatic speech recognition device).

Training Data* [ASR]--Speech material used to construct parametric representations of speech such as template sets or word models used by a recognizer. Also referred to as enrollment data. Not to be confused with performance data obtained in training potential users of the technology.

TTY [TRS]--Converted Western Union teletypewriters that, when used with an acoustic coupler, allow two-way telephone communication by typing. Forerunners of the current TDDs, some TTYs are still in use. Some people prefer TTY over TDD as a term for all telecommunication terminals used by deaf people.

Utterance* [ASR]--A word or multi-word phrase spoken continuously as a single unit.

Vocabulary* [ASR]--The words or phrases to be recognized by a recognizer. Distinctions should be made between the complete set of all words and phrases that a recognizer has been trained or programmed to recognize, sometimes called the total *recognition vocabulary*, and the (instantaneously varying) subset of these that may be active at a given time because of an imposed task grammar or other syntactic constraint, called the *active vocabulary*.

Voice Carryover [TRS]--Method of relaying a call that permits the hearing impaired person in the conversation to speak rather than type his or her message; also permits speech impaired people to hear rather than have typed to them the message of the speaking person.

Voice Pass-Through [TRS]--Synonym for voice carryover.

Word* [ASR]--See "recognition unit."

* These definitions are from: Pallett, D.S. (1985). Performance assessment of automatic speech recognizers, *Journal of Research of the National Bureau of Standards, 90*,(5). The definitions were supplied by James Glenn in his tutorial review of automatic speech recognition.

Gallaudet University President I. King Jordan (left) talks with Merv Garretson, special assistant to the President at Gallaudet, (center) and Congressman Major Owens, who gave the conference's keynote address.

LIST OF CONFERENCE SPEAKERS

ALLEN, MARIN
Associate Professor and Chairperson
Department of TV, Film, and Photography
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

BAQUIS, DAVID
Special Needs Manager
Tele-Consumer Hotline
1910 K Street, N.W.
Suite 610
Washington, DC 20006

BERNSTEIN, JARED
Staff Scientist
EK 168
SRI International
333 Ravenswood Avenue
Menlo Park, CA 94025

BRACKNEY, STUART
Director
The Arizona Council for the Hearing Impaired
1300 West Washington
Phoenix, AZ 85007

CARSON, LINDA
Vice President of Production
National Captioning Institute, Inc.
5203 Leesburg Pike
15th Floor
Falls Church, VA 22041

CONLON-MENTKOWSKI, SHEILA
Director
Norcal Center for Law and the Deaf
2045 Hallmark Drive, Suite 4
Sacramento, CA 95825

CUTLER, WILLIAM
President
Board of Trustees
Self Help for Hard of Hearing People, Inc.
2590 Marshall Drive
Palo Alto, CA 94303

DeGENNARO, STEVEN V.
Research Staff Member
Thomas J. Watson Research Center
P.O. Box 218
Route 134 East
Yorktown Heights, NY 10598

GLENN, JAMES
Manager
Development Programs
Entropic Speech, Inc.
600 Pennsylvania Avenue, S.E.
Suite 202
Washington, DC 20003

HARKINS, JUDITH E.
Director
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

HEIL, JOSEPH
47 Ralph Place
Morristown, NJ 07960

HINTON, DANIEL
Science Applications International Corporation
135 Old Solomons Island Road
Annapolis, MD 21401

HOTCHKISS, DAVID
Research Associate
Center for Assessment & Demographic Studies
Gallaudet Research Institute
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

HURST, MICHAEL
Attorney
AT&T
795 Folsom Street
Room 670
San Francisco, CA 94107

HUTCHINS, JEFF
Vice President
American Data Captioning, Inc.
312 Boulevard of Allies, Suite 200
Pittsburgh, PA 15222

JENSEMA, CARL J.
Senior Research Scientist
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

JORDAN, I. KING
President
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

LEVESQUE, JACK
Director
Deaf Counseling Advocacy & Referral Agency
125 Parrott Street
San Leandro, CA 94577

LINDBERG, KARIN
Norwegian Telecom Administration
Universitetsgatan 7
Oslo 1
NORWAY

NILSSON, BÖRJE
Manager
Telekontoret
Swedish Telecom
P.O. Box 935
391 29 Kalmar
SWEDEN

NORWOOD, MALCOLM
6619 Adrian Street
New Carrollton, MD 20784

OLIVER, WILLIAM
Immediate Past President
National Shorthand Reporters Association
Stenograph Institute of Arkansas
350 Union Station Square
Little Rock, AR 72201

OWENS, MAJOR R.
Chairman
Subcommittee on Select Education
Committee on Education and Labor
The U.S. House of Representatives
114 Cannon House Office Building
Washington, DC 20515

RANSOM, PAMELA
Executive Director
Chicago Hearing Society
10 West Jackson Boulevard
Chicago, IL 60604

SCARCELLA, JOHN
Regional Sales Manager
Kurzweil Applied Intelligence
4041 Powder Mill Road
Suite 300
Calverton, MD 20705

SCHAEFFER, ESTHER
President
Telecommunications Exchange for the Deaf, Inc.
P.O. Box 508
Great Falls, VA 22066

SHAPIRO, PHYLLIS
Manager
California Relay Service
20931-A Burbank Boulevard
Woodland Hills, CA 91367

SINGLETON, PAUL
Vice President
National Association of the Deaf
814 Thayer Avenue
Silver Spring, MD 20910

SONNENSTRAHL, ALFRED
Executive Director
Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, MD 20910

STRAUSS, KAREN
National Center for Law and the Deaf
Gallaudet University
800 Florida Avenue, N.E.
Washington, DC 20002

STUCKLESS, ROSS
Director
Integrative Research
National Technical Institute for the Deaf
One Lomb Memorial Drive
Rochester, NY 14623

TAYLOR, PAUL
National Technical Institute for the Deaf
Building 14
One Lomb Memorial Drive
Rochester, NY 14623

TOLENSKY, ROBERT
Bell Canada
15th Floor
393 University Avenue
Toronto, Ontario
CANADA M5G 1W9

WOODS, KATHY
Senior Policy & Compliance Analyst
New York State Department of Public Service
Third Floor
3 Empire State Plaza
Albany, NY 12223

The conference exhibits provided a glimpse of current and near-future products in telecommunications and captioning. Representatives of the Stenograph Corporation are pictured at their exhibit table.

LIST OF CONFERENCE EXHIBITORS

BARONDATA SYSTEMS
1700 Marina Boulevard
San Leandro, CA 94577
(415) 352-8101 ext. 517

BELL COMMUNICATIONS RESEARCH (BELLCORE)
445 South Street
Morristown, NJ 07960
(201) 829-4432

COMPUTER PROMPTING CORPORATION
3408 Wisconsin Avenue, N.W.
Suite 201
Washington, DC 20016
(202) 966-0980

CONTACT USA–DEAF CONTACT
Katzenbach School for the Deaf
320 Sullivan Way CN535
Trenton, NJ 08625
(609) 883-2880

HARC MERCANTILE, LTD.
P.O. Box 3055
Kalamazoo, MI 49003
(800) 253-3252

INTEGRATED MICROCOMPUTER SYSTEMS, INC.
2 Research Place
Rockville, MD 20850
(301) 869-6391

KROWN RESEARCH, INC.
10371 West Jefferson Boulevard
Culver City, CA 90232
(800) 833-4968

NATIONAL CAPTIONING INSTITUTE, INC.
5203 Leesburg Pike - Suite 1500
Falls Church, VA 22041
(703) 998-2420

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION
135 Old Solomons Island Road
Annapolis, MD 21401
(202) 261-8424

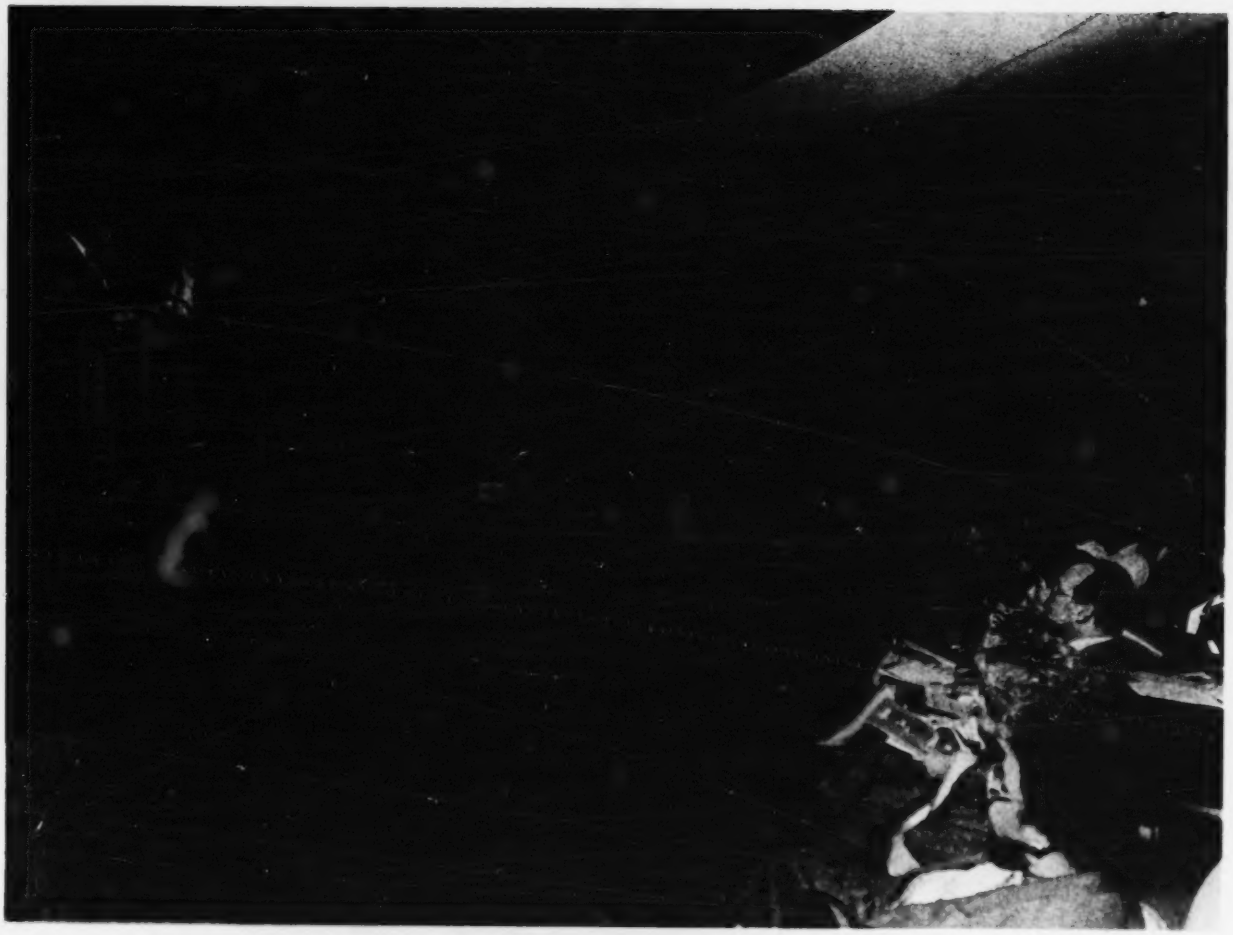
SELECTIVE TECHNOLOGIES, INC.
10 Brickett's Mill Road
Hampstead, NH 03841
(603) 329-8213

STENOGRAPH CORPORATION
1500 Bishop Court
Mt. Prospect, IL 60056
(312) 803-1400

TELECOMMUNICATIONS EXCHANGE FOR THE DEAF, INC. (TEDI)
P.O. Box 508
Great Falls, VA 22066
(703) 759-2993

ULTRATEC, INC.
6442 Normandy Lane
Madison, WI 53719
(608) 273-0707

XSCRIBE CORPORATION
6160 Cornerstone Court East
San Diego, CA 92121
(800) 356-0114



The four-day conference attracted more than 300 people from 37 states and five foreign countries.

LIST OF CONFERENCE PARTICIPANTS

ABRAMS, KATHERINE S.
NYNEX Service Company
120 Bloomingdale Road
White Plains, NY 10605

AKENS, KEVIN
120 Antler Road
Fredericksburg, VA 22401

AINBENDER, HILARY R.
Instructor, Department of English
School of Preparatory Studies
Gallaudet University
Washington, DC 20002

ALPERT, RENATE
Volunteer
Deaf Program at Bellevue Hospital
40 East 83rd Street
New York, NY 10028

ALTER, EILEEN
Chair, Texas Relay Service
Texas Association on Deafness
510 South Congress Avenue
Austin, TX

ANTHONY, PHILIP
Otologist
901 Hemphill
Fort Worth, TX 76104

ARDINGER, ROBERT
Department of Housing & Urban Development
451 7th Street, SW
Washington, DC 20410

AUGLIERE, DEB
Operations Manager
The Caption Center
125 Western Avenue
Boston, MA 02134

BAK, THOMAS
Management Analyst
HUD
451 Seventh Street, SW
Washington, DC 20410

BARBIN, HUEY
LAD TV/Media Co-Chairman
Lousiana Association of the Deaf
290 Kenwood Avenue
Baton Rouge, LA 70806

BAROVIAN, DAVID J.
Dealer
TDD Sales and Services
944 Chelston Avenue
South Euclid, OH 44121

BART, DANIEL L.
Senior Attorney
GTE Service Corporation
1850 M Street, NW, Suite 1200
Washington, DC 20036

BARTO, CHERYL
Information Specialist
National Information Center on Deafness
Gallaudet University
Washington, DC 20002

BASEY, PATTY
OSD Operator
AT&T Operator Services
725 13th Street, NW, Room 701
Washington, DC 20005

BAUER, JUDI
Provincial Coordinator
Educational Support Services
The Canadian Hearing Society
271 Spadina Road
Toronto, Ontario
CANADA M5R 2V3

BELTON, BRENDA
Product Manager
Bell Atlantic
13100 Columbia Pike--C32
Silver Spring, MD 20904

BENDER, TIM
Director
Relay Center for the Deaf
127 Erlanger Road
Erlanger, KY 41018

BENNETT, PETER H.
Vice President
Telecommunications Industry Association
1722 Eye Street, NW--Suite 440
Washington, DC 20006

BENNETT, RICHARD
Regional Manager
Stenograph Corporation
23 Mountain Laurel Drive
Clifton Park, NY 12065

BENNETT, WAYNE
Telephone Task Force
Louisiana Association of the Deaf
P.O. Box 3074
Baton Rouge, LA 70821

BERG, OTTO B.
TEDI Board
127 6th Street, NE
Washington, DC 20002

BILLOTTE, STEVE
Vice President, Product Development
ITI
108 South Ackard
Dallas, TX 75202

BITLER, DORIS
Research Assistant
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

BOONE, DONALD W.
Manager
AT&T
3201 Jermantown Road, Room 3-B
Fairfax, VA 22030

BRAND, KELLY
Legislative Analyst
Bellcore
2101 L Street, NW, Suite 600
Washington, DC 20037

BRANDT, FRED
Department of Audiology
School of Communication
Gallaudet University
Washington, DC 20002

BRAUN, BARBARA J.
Assistant Manager
Marketing & Customer Services
Wisconsin Bell, Inc.
740 North Broadway--Room 105
Milwaukee, WI 53202

BREUNIG, H. LATHAM
Alexander Graham Bell
Association for the Deaf
7108 27th Road North
Arlington, VA 22213

BRODY, LEE
Executive Director
Phone TTY, Inc.
202 Lexington Avenue
Hackensack, NJ 07601

BROOKS, LENORE
Assistant Professor
Department of Mathematics & Computer Science
Gallaudet University
Washington, DC 20002

BROWN, JOANN S.
Rehabilitation Counselor
VA Department of Rehabilitative Services
4901 Fitzhugh Avenue
Richmond, VA 23230

BROWN, MARY M.
Group Manager
AT&T--California Relay Service
20931-A Burbank Boulevard
Woodland Hills, CA 91367

BRUNNER, MIKE
Graduate Student
Gallaudet University
Washington, DC 20002

BUNNELL, H. TIMOTHY
Research Scientist
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

BURKE, ELISE
LAD TV/Media Co-Chairman
Louisiana Association of the Deaf
15708 Riverdale Avenue, E
Baton Rouge, LA 70816

BURNS, MIRIAM V.
Personnel Staffing Specialist
DHHS - Social Security Administration
6401 Security Blvd., Room G-122 WHR
Baltimore, MD 21207

BUSE, MARK
111 Russell Senate Office Building
Washington, DC 20510

CALEY, JAMES D.
Interpreter/Coordinator of Deaf Services
Berks County Association for the Hearing Impaired, Inc.
223 North 6th Street
Reading, PA 19601

CARTER, CYNTHIA E. ABNEY
Director/Coordinator
Link Relay Message
Service for the Hearing and Speech Impaired
P. O. Box 3638
251 West Street
Annapolis, MD 21403

CASSIDY, JANET
Shorthand Reporter
American Data Captioning
2511 Foxcroft Way
Reston, VA 22091

CHERTOK, BARBARA L.
Instructor of Speechreading
Montgomery College
4940 Sentinel Drive, #205
Bethesda, MD 20816

COBER, CAROL
The National Academy
College for Continuing Education
Gallaudet University
Washington, DC 20002

COLLUMS, CHARLOTTE
Division of Rehabilitation Services
Office for the Deaf & Hearing Impaired
6408 Hawthorne Road
Little Rock, AR 72207

COLWELL, KEVIN
Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719

CONOVER, EVELYN B.
Director, DEAF CONTACT
CONTACT of Mercer County, NJ
320 Sullivan Way--CN-535
Trenton, NJ 08525

COUTIS, VICKI
Intake/Outreach Supervisor
Center of Resources for Independent People
707 North 7th, Suite A
Pocatello, ID 83201

CURIONI, DAVID N.
Market Research Manager
ITI
108 S. Akard
Dallas, TX 75202

DAHILL, JAY
BaronData
1700 Marina Boulevard
P. O. Box 2193
San Leandro, CA 94577

DANIELS, ROBERT
Marketing Representative
Captioning Concepts, Inc.
18425 Burbank Blvd., Suite 404
Tarzana, CA 91356

DANOWSKI, MARGARET V.
Executive Director
Berks County Association for the
Hearing Impaired, Inc.
223 North 6th Street
Reading, PA 19601

DARNELL, VICKI
Administrative Secretary
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

DAVIES, SHAWN
Scientific Communications Coordinator
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

DAVIS, ALVIN J.
Executive Director
Constance Brown Hearing & Speech Center
1521 Gull Road
Kalamazoo, MI 49001

DAVIS, JOE
Regional Manager
Metrocast
400 East Pratt Street, Suite 827
Baltimore, MD 21201

DAVITON, LAURA
Deaf Services Advocate
Northern Nevada Center for Independent Living
624 East 4th Street
Reno, NV 89512

DECKER, SUE
Product Manager
AT&T Special Needs Center
2001 Route 46, Waterview Plaza
Parsippany, NJ

DETTHOW, ANNICA
Student
Gallaudet University
Washington, DC 20002

DETTMAN, MARY JANE
Speech Pathologist
2979 Meadow Lane
Westlake, OH

DILLEHAY, JANE REEHL
Associate Professor
Department of Biology
Gallaudet University
Washington, DC 20002

DIPIETRO, LORAINE
Director
National Information Center on Deafness
Gallaudet University
Washington, DC 20002

DITTMAN, DOUG
Systems Director
The Caption Center
125 Western Avenue
Boston, MA 02134

DIVERS, EDWARD
Department of Defense
9800 Savage Road
Ft. Meade, MD 20755

DREYFUS, BARBARA
Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719

DRISCOLL, PENNY
Manager
Bell Atlantic, NSS
2101 L Street, NW--Room 510
Washington, DC 20037

DUKES, ANDRE
Metrocast
9030 Route 108
Columbia, MD 21045

DUNCAN, EARLENE
Information Specialist
National Information Center on Deaf-Blindness
Gallaudet University
Washington, DC 20002

DUNN, SALLY
Office Services Supervisor
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

EDWARDS, ANNE
Equal Opportunity Specialist
U.S. Department of Health & Human Services
112 Sunnyside Road
Silver Spring, MD 20910

EICHELBERGER, M. J.
Vice President--Operations
Illinois Telecommunications Access Corp.
P. O. Box 64509
Chicago, IL 60664

ELLIS, DORETTA
TDD Staff Liaison
Illinois Commerce Commission
527 East Capitol Avenue
Springfield, IL 62706

EMMANUEL, DILLIP
System Engineer
Integrated Microcomputer Systems, Inc.
2 Research Pike
Rockville, MD 20850

ENDERS, MARILYN
Senior Captioning Production Specialist
National Technical Institute for the Deaf
One Lomb Memorial Drive
Rochester, NY 14623

ENGELKE, ROB
Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719

ENTSMINGER, MEGAN M.
Program Worker I
KS Commission for the Deaf & Hearing Impaired
300 SW Oakley
Biddle Building, 1st Floor
Topeka, KS 66606

ERICKSON, MARY ANN
Coordinator
NTID Telecommunications Center
National Technical Institute for the Deaf
Mark Ellingson Hall, Room 1030
One Lomb Memorial Drive
Rochester, NY 14623

ERTING, CAROL
Director
Culture & Communication Studies
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

ESTES, CHARLES C.
Department of Human Services
8308 NW 35th
Bethall, OK 73008

ESTHER, DIANNA
Area Manager, Federal Docket Management
Southwestern Bell Telephone Co.
1010 Pine, Room 1520
St. Louis, MO 63101

FARRAND, WILLIAM PARKER
Computer Specialist
HUD
451 Seventh Street, SW
Washington, DC 20410

FETTER, STEVEN M.
Commissioner
Michigan Public Service Commission
6545 Mercantile Way--P.O. Box 30221
Lansing, MI 48909

FINK, BARBARA
3009 Decatur Avenue
Kensington, MD 20895

FOSTER, RICHARD W.
Service Manager--Special Networks Planning
Illinois Bell Telephone Company
225 W. Randolph--HQ26D
Chicago, IL 60606

FRANKE, STEVE
Supervisor
Consumer & Directory Services
Cincinnati Bell Telephone
201 East 4th Street--Bldg. 102-139
Cincinnati, OH 45206

GARCIA, MILO F.
Research Technician
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

GARNER, K. C.
District Manager
Bellcore
290 West Mt. Pleasant Avenue, Room LCC-2B-252
Livingston, NJ 07039

GAVONI, CHARLIE
BaronData
1700 Marina Boulevard
P. O. Box 2193
San Leandro, CA 94577

GENDEL, JOSHUA M.
Director
Technical Services Department
NY League for the Hard of Hearing
71 West 23rd Street
New York, NY 10010

GEORGE, ROBIN A.
Tour Guide
Federal Bureau of Investigation
10th & Pennsylvania Ave., NW
Washington, DC 20535

GERLIS, IRA
Independent Living Counselor
Division of Rehabilitation Services
Office for the Deaf & Hearing Impaired
4324 Markham Street
Little Rock, AR 72205

GLASSMAN, MARTIN S.
Research Scientist
Siemens Corporate Research
105 College Road East
Princeton, NJ 08540

GOLDBERG, LARRY
Director
The Caption Center
125 Western Avenue
Boston, MA 02134

GRIER, DARYL
Assistant Staff Manager--Regulatory
Wisconsin Bell, Inc.
722 North Broadway, 9th Floor
Milwaukee, Wisconsin 53202

GROSSMAN, MICHAEL
Production Coordinator
The Caption Center
125 Western Avenue
Boston, MA 02134

GUERRIERI, VINCE
Manager
Bell Atlantic, NSS
2101 L Street, NW--Room 510
Washington, DC 20037

HAAS, JOYCE
120 Antler Road
Fredericksburg, VA 22401

HAGOPIAN, HAROLD M.
Official Court Reporter
United States District Court
202 Harlow Street
P. O. Box 1007
Bangor, Maine 04401

HAINES, CHARLES
Professor of English
Carleton University
Room 302, Administration Building
Ottawa, Ontario
CANADA K1S 5B6

HAIRSTON, ERNEST E.
Educational Program Specialist
U.S. Department of Education
Office of Special Education Programs
400 Maryland Avenue, SW
Washington, DC 20202

HALL, ANNA S.
Caption Club Coordinator
National Captioning Institute
5203 Leesburg Pike
Falls Church, VA 22041

HAMILTON, CONNIE
OSD Operator
AT&T Operator Services
725 13th Street, NW, Room 701
Washington, DC 20005

HARDING, RONALD N.
Associate Manager
BellSouth Services
2121 8th Avenue N.
Birmingham, AL 35203

HARKINS, JUDITH E.
Director
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

HARTMAN, MICHAEL
Personnel Staffing Specialist
U.S. Department of Health & Human Services
200 Independence Avenue, SW
Room 536E--Humphrey Building
Washington, DC 20201

HATLEY, RONALD G.
External Relations Manager
AT&T National Special Needs Center
2001 Route 46, Suite 300
Parsippany, NJ 07054-1315

HENRY, PAMELA V.
Total Communication Teacher
White Oak School
4801 Leefield Road
Baltimore, MD 21234

HEPPNER, CHERYL
Outreach Specialist
VA Dept. for Deaf & Hard of Hearing
664 Seldon Drive
Winchester, VA 22601

HIRSH, ANNE E.
Human Factors Consultant
Job Accommodation Network
West Virginia University
809 Allen Hall, P.O. Box 6122
Morgantown, WV 26505

HOEWING, LINCOLN
Director
Bell Atlantic
1310 N. Court House Road, 10th Floor
Arlington, VA 22201

HOLDEN-PITT, LISA
Research Associate
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

HOLLER, JAN
US West
6200 South Quebec
Englewood, CO 80111

HOOD, CAROL E.
Graduate Student
Gallaudet University
Washington, DC 20002

HOSKINSON, FLOYD A.
DPR Specialist
AT&T
3201 Jermantown Rd., #4A
Fairfax, VA 22030

HUGHES, PATTY
TDD Project Coordinator
Dept. of Social & Health Services
12th & Franklin; MS: OB-42A
Olympia, WA 98504

HYSSONG, PHIL
Executive Producer
Lutheran Television & Media Productions
7400 Augusta, Box 24S
River Forest, IL 60305

JAMES, ROBERT
Senior Electronics Engineer
Federal Communications Commission
1919 M Street, NW
Washington, DC 20554

JENSEMA, CARL J.
Senior Research Scientist
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

JEPSEN, PETER LEE
Real-Time Captioning Consultant
Xscribe Corporation
P.O. Box 585
Fairmont, MN 56031

JOHNSON, RICHARD K.
National Institute on Disability
and Rehabilitation Research
U.S. Department of Education
330 C Street, SW
Washington, DC 20202

JOHNSON, ROBERT
Research Editor
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

JORDAN, CLAY C.
Deaf Advocate
47 Old Neck Road
Scarborough, Maine 04074

KAPLAN, HARRIET
Department of Audiology
Gallaudet University
Washington, DC 20002

KARCHMER, MICHAEL
Dean
Graduate Studies and Research
Gallaudet University
800 Florida Avenue, NE
Washington, DC 20002

KAY, FRED M.
Director
Bell Atlantic
1310 N. Courthouse Road
Arlington, VA 22201

KENT, CHERYL
Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410

KIGHT, E. H.
President
Stenograph Corporation
7300 Niles Center Road
Skokie, IL 60077

KINBERG, ROBERT
Vice President
Power International, Inc.
2127 Espey Court
Crofton, MD

KING, CHARLES M., JR.
Executive Vice President & General Manager
East Ascension Telephone Co., Inc.
913 S. Burnside Avenue
Gonzales, LA 70737

KING, HEATHER
Manager
Advanced Telephone, Inc.
913 S. Burnside Avenue
Gonzales, LA 70737

KING, SUSAN J.
Coordinator of Research Data Systems
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

KIRK, EDWARD J.
Manager
Bell Atlantic
1310 North Court House Road, 3rd Floor
Arlington, VA 22201

KLEBERG, MARCELLUS A.
Offset Stripper
U.S. Government Printing Office
3307 Ferndale Street
Kensington, MD 20895

KLEEB, BEAT
Vice President
Swiss Federation of the Deaf
Weissenrainstrasse 52
CH-8707 Uetikon
SWITZERLAND

KONIGSBERG, IRA
2770 W. 5th Street
Brooklyn, NY 11224

KOONTZ, JACK
Washington County DeafNet Association, Inc.
P.O. Box 2619
Hagerstown, MD 21740

KOONTZ, PEGGY
Washington County DeafNet Association, Inc.
P.O. Box 2619
Hagerstown, MD 21740

KORRES, ELLIE
Research Assistant
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

KOZHA-SPYTEK, LINDA
Research Assistant
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

KRONGOLD, RALPH
President
Krown Research, Inc.
10371 West Jefferson Boulevard
Culver City, CA 90232

LA BROSSE, DAN
Graduate Student
Rehabilitation Counseling
Gallaudet University
Washington, DC 20002

LAUER, FRANCINE
Rights Representative
Division of Deaf and Deafened
309 N. Washington Square, Box 30015
Lansing, MI 48909

LAYNG, SANDERSON
President
The Canadian Captioning Development Agency, Inc.
95 Barber Greene Road, Suite 208
Toronto, Ontario
CANADA

LEARY, KAREN NEALE
Program Director
Ingraham Volunteers, Inc.
74 Elm Street
Portland, ME 04064

LEE, CHARLES C.
Project Manager
Trace R & D Center
1500 Highland Avenue
Madison, WI 53705

LETCHER, ELEANOR K.
Executive Director
CONTACT of Mercer County, NJ
320 Sullivan Way--CN-535
Trenton, NJ 08525

LOPEZ, CARMEN M.
DPR Staff Manager
AT&T
3201 Jermantown Rd., #4A
Fairfax, VA 22030

LOWE, ANDREW H.
Computer Programmer
U.S. Environmental Protection Agency
401 M Street, SW
Washington, DC 20460

LUCERO, DAN
National Captioning Institute
5203 Leesburg Pike
Falls Church, VA 22041

LUKALA, FREDA
Manager of Operator Services
Edmonton Telephone
10044 108th Street
Edmonton, Alberta
CANADA T5J 3S7

LUPO, FRANCES
22-10 80th Street, Apt. 3D
East Elmhurst, NY 11370

MADAY, DANIEL E.
Special Assistant
GSA - Board of Contract Appeals
18th & F Streets, NW--Room 7210
Washington, DC 20405

MALCOLM, RICHARD
LAD Representative
Louisiana Association of the Deaf
11413 Moultrie Avenue
Baton Rouge, LA 70817

MARCUS, SHIRLEY E.
Director
Maryland Energy Assistance Program
311 W. Saratoga Street, Room 221
Baltimore, MD 21201

MARKEL, RON
Washington County DeafNet Association, Inc.
P.O. Box 2619
Hagerstown, MD 21740

MARQUIS, JEANNE GLIDDEN
Education Resources Coordinator
National Information Center on Deaf-Blindness
Gallaudet University
Washington, DC 20002

MARTIN, JANICE
Executive Director
Frederick County Services
for the Hearing Impaired, Inc.
P.O. Box 3104
Frederick, MD 21701

MATELSKI, STAN
Director
Office of Sponsored Programs
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

MAYES, JULIA
Gallaudet Ambassador--Visitor's Center
Gallaudet University
9249 Three Oaks Drive
Silver Spring, MD 20901

MAZUR, JOSEPH
Executive Director
Catskill Center for Independence, Inc.
Rt. 23, Southside--P.O. Box 1247
Oweowta, NY 13820

McCANN, JO ANN
Educational Program Specialist
Office of Special Education Programs
U.S. Department of Education
4030 Chesapeake Drive
Edgewater, MD 21037

McCLOSKY, LARRY
Coordinator for Disabled
Carleton University
Room 302, Administration Building
Ottawa, Ontario
CANADA K1S 5B6

MEASE, CINDY
Washington County DeafNet Association, Inc.
P.O. Box 2619
Hagerstown, MD 21740

MENTER, SCOTT F.
Instructional Television/Media Specialist
Louisiana School for the Deaf
P.O. Box 3074
Baton Rouge, LA 70821

MENZEL, OTTO J.
Route 4
371 TVA Road South
Bristol, TN 37620

MESSERLY, JUNE L.
Director, Deaf Services
CONTACT Harrisburg
P.O. Box 2328
Harrisburg, PA 17105

METZ, KURT
Graduate Assistant
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

MILES, EDWARD
Program & Services Coordinator
Catskill Center for Independence, Inc.
Rt. 23, Southside
P.O. Box 1247
Oweowta, NY 13820

MILLER, JEANNE
Independent Living Supervisor
Division of Rehabilitation Services
Office for the Deaf & Hearing Impaired
P.O. Box 3781
Little Rock, AR 72203

MILLS, ROBERT
Electronic Industries Foundation
Suite 700
1901 Pennsylvania Avenue, NW
Washington, DC 20006

MIZELL, CHARLES M.
4103 Wynnwood Drive
Annandale, VA 22003

MOLCHAN, JOHN
District Manager--New Product Management
AT&T
295 North Maple Ave., Room 221963
Basking Ridge, NJ 07920

MOORE, MARILYN
Supervisor
Michigan Public Service Commission
P.O. Box 30221
Lansing, MI 48909

MORRIS, L. R.
Professor
Carleton University
Colonel By Drive
Ottawa, Ontario
CANADA K1S 5B6

MORRIS, REBECCA
Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410

MORRIS, ROBERT
Professor of Engineering
Carleton University
Room 302, Administration Building
Ottawa, Ontario
CANADA K1S 5B6

MORRIS, SUSAN C.
Field Representative
Nebraska Commission for the Hearing Impaired
3223 North 45th Street
Omaha, NE 68104

MORRISON, DAN
Science Applications International
135 Old Solomons Island Road
Annapolis, MD 21401

MOSS, GREG
Computer Prompting Corporation
3408 Wisconsin Avenue, NW
Washington, DC 20016

MUDD, KATHLEEN L.
Project Director
Jacksonville Community Center for the Deaf
907 West Superior
Jacksonville, IL 62650

MUTTON, RUSS
Director of Instructional Media
Carleton University
Room 302, Administration Building
Ottawa, Ontario
CANADA K1S 5B6

NEWBURGER, SUSAN
Program Development Specialist
Professional and Community Training Programs
The National Academy
Gallaudet University
Washington, DC 20002

NEZZO, CAROL
Analyst
U.S. Congress Office of Technology Assessment
Washington, DC 20510

NIEMI, JAMES ERNEST
Computer Systems Analyst
Health Care Financing Administration
1577 Crofton Parkway
Crofton, MD 21114

NIX, STEPHEN C.
Equal Opportunity Specialist
IBM Corporation
P.O. Box 12195 D664/B205
Research Triangle Park, NC 27709

NOMELAND, RONALD E.
Professor & Chair
Department of Educational Technology
Gallaudet University
Washington, DC 20002

NORWOOD, CYNTHIA H.
Assistant to the Commission
VA State Corporation Commission
P. O. Box 1197
Richmond, VA 23209

O'BRIEN, DENNIS T.
Planning Manager, Special Needs Systems
IBM
P.O. Box 1328
Boca Raton, FL 33432

O'DONOGHUE, LIZANN
Staff Specialist
AT&T
201 3rd Street, Room 1150
San Francisco, CA 94103

OLIA, FATEMEH
Assistant Professor
Department of Educational Technology
Gallaudet University
Washington, DC 20002

OTIS, WILLIAM D.
Coordinator, R & D
Columbus State Community College
550 East Spring Street, Box 1609
Columbus, OH 43216

PAINTER, LEE W.
1410 Chowan Road
Richmond, VA 23229

PAVIN, ROBERT
Selective Technologies, Inc.
10 Bricketts Mill Road
Hampstead, NH 03841

PEACE, WILLIAM H.
Director
North Carolina Commission for the Hearing Impaired
Division of Vocational Rehabilitation Services
P. O. Box 26053
Raleigh, NC 27611

PERKINS, MADELAINE P.
Project Director
Utah Association for the Deaf
388 North 400 East, #218
Bountiful, Utah 84010

PERRY, NANCY T.
Consumer Affairs Manager
C & P Telephone
1 East Pratt Street, 7-E
Baltimore, MD 21202

PERRY, PAT
Associate Director
NYNEX
120 Bloomingdale Road
White Plains, NY 10706

PHILLIPS, L. E.
Manager - Issues Management
BellSouth Corporation
1155 Peachtree Street, Room 19G03
Atlanta, GA 30367-6000

PREZIOSO, CARLENE
Research Associate
Culture & Communication Studies
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

PRICKETT, HUGH
Director, Center on Deafness
Western Maryland College
Westminster, MD 21157

RADFORD, BRENDA L.
DPR Clerk
AT&T
3201 Jermantown Road, Room 4-B
Fairfax, VA 22030-2885

RAFIQ, WANDA M.
Computer Programmer/Analyst
Federal Emergency Management Agency
5321 Riggs Road
Gaithersburg, MD 20879

RAMOS, DAVID
Selective Technologies, Inc.
10 Bricketts Mill Road
Hampstead, NH 03841

RANDALL, ANTHONY T.
Executive Director
Michigan Association for Deaf, Hearing and Speech Services
724 Abbott Road
East Lansing, MI 48823

REBICK, JUDY
Director, Special Projects
The Canadian Hearing Society
271 Spadina Road
Toronto, Ontario M5R 2V3
CANADA

RIELY, CYNTHIA
Consumer Liaison
Maryland People's Counsel
231 East Baltimore Street
Baltimore, MD 21202

RIGBY, JOYCE C.
Staff Member
Applied Concepts Corporation
107 North Kent Street
Suite 200
Winchester, VA 22601

ROANE, BERNICE V.
Manager
AT&T Operator Services
725 13th Street, NW, Room 701
Washington, DC 20005

ROBBINS, CURT
Assistant Professor
Department of Educational Technology
Gallaudet University
Washington, DC 20002

ROBINSON, GLORIA J.
Staff Manager
Bell Atlantic
1310 N. Court House Road
Arlington, VA 22201

RODGERS, DOROTHY C.
47 Old Neck Road
Scarborough, Maine 04074

ROSEN, RICHARD F.
Director
CAPCOM, Inc.
5010 Wisconsin Avenue, NW--Suite 118
Washington, DC 20016

ROSEN, ROSLYN G.
Dean
College for Continuing Education
Gallaudet University
Washington, DC 20002

ROTHMAN, CINDY
Computer Programmer Analyst
Internal Revenue Service
Pennsylvania Avenue & 12th Street, NW
Washington, DC 20224

ROURKE, ROBERT F.
Computer Programmer
U.S. Army Corps of Engineers
2500 First Street, NW
Washington, DC 20001

RUPP, SUSAN
Representative
US West
339 South Downing Street
Denver, CO 80209

RUSSO, JOANNE
Speech Pathologist
Bergen County Board of Special Programs
Prospect Avenue
Midland Park, NJ

RYAN, ELIZABETH
Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410

SAFER, NANCY D.
Director, Division of Educational Services
Office of Special Education Programs
U.S. Department of Education
400 Maryland Avenue, SW
Washington, DC 20202-2644

SCHEFFEL, ROBERT E.
Chairperson of TDAP Advisory Committee
Public Utility Commission
Labor & Industries Building
Salem, OR 97310-0335

SCHMITT, DEBORAH
Bellcore
445 South Street
Morristown, NJ

SCHOOLEY, BRENDA
806 Fairmount Avenue
Atlantic City, NJ 08401

SCHWARTZ, DAVID M.
Computer System Analyst Programmer
United States Government
7308 Layton Drive
Springfield, VA 22150

SCOTT, JEWEL
Assistant Manager
AT&T Operator Services
725 13th Street, NW, Room 701
Washington, DC 20005

SEEGER, MARK
Program Specialist
Texas Commission for the Deaf
P.O. Box 12904, Capitol Station
Austin, TX 78701-2904

SERVELLON, CESAR
Physician
761 Delaware Avenue, SW
Washington, DC 20024

SHERMAN, RENEE
Project Director
Pelavin Associates
1300 N Street, NW, Suite 500
Washington, DC

SHUART, ADELE K.
Client Assistance Program Specialist
Division of Vocational Rehabilitation
501 St. Paul Street, Suite 1308
Baltimore, MD 21202

SIKORSKI, STAN
Sales Manager
Krown Research, Inc.
10371 West Jefferson Boulevard
Culver City, CA 90232

SLAGER, RONALD D.
Vice President
HARC Mercantile, Ltd.
HAC of America
P.O. Box 3055
Kalamazoo, MI 49003

SMALLEY, CAROL
Executive Director
CONTACT 609
1050 N. Kings Highway
Cherry Hill, NJ 08034

SMITH, DOTTI
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

SMITH, FRANK
Stenograph Corporation
320 Canterwood Lane
Great Falls, VA 22066

SMITH, W. LEON
Executive Board Member
Washington Area Group for
the Hard of Hearing, Inc.
14109 Burning Bush Lane
Silver Spring, MD 20906

SOFINSKI, BRUCE
TDD Programs Coordinator
VA Dept. for the Deaf & Hard of Hearing
101 N. 14th Street
James Monroe Building, 7th Floor
Richmond, VA 23219-3678

SOM, DILIP
Computer Prompting Corporation
3408 Wisconsin Avenue, NW
Washington, DC 20016

SONNENSTRAHL, ALFRED
Executive Director
Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, MD 20910

SONNENSTRAHL, EDWARD
2225 West 106th Street
New York, NY 10025

SOUKUP, BENJAMIN
Executive Director
Communication Services for the Deaf
3520 Gateway Lane
Sioux Falls, SD 57106

SPANNER, MICHAEL
Head of Telecommunications
Royal National Institute for the Deaf
105 Gower Street
London, ENGLAND

STARK, BILL
Director of Community Service
Programs for the Deaf and the Blind
SC School for the Deaf and the Blind
Cedar Spring Station
Spartanburg, SC 29302

STEEL, JAMES
Chief Engineer
Phone TTY, Inc.
202 Lexington Avenue
Hackensack, NJ 07601

STEEVER, GAIL
Director of Public Relations
Telecommunications for the Deaf, Inc.
814 Thayer Avenue
Silver Spring, MD 20910

STERN, VIRGINIA W.
Director
Project on Science, Technology, & Disability
American Association for Advancement of Science
1333 H Street, NW
Washington, DC 20005

STROUP, FRIEDA L.
Special Education Teacher
Montgomery County Public Schools
11513 Lockwood Drive, #7
Silver Spring, MD 20904

SUEDA, RETHA A.
Electronic Engineer
9276 Pirates Cove
Columbia, MD 21046

SUMBRY, GLADYS
Department of Housing and Urban Development
451 7th Street, SW
Washington, DC 20410

SUMER, CHARLES
Marketing Representative
Xscribe Corporation
7833 Walker Drive--Suite 317
Greenbelt, MD 20770

TAHLOR, AMIE
Computer Programmer
U.S. Army Corps of Engineers
2500 First Street, NW
Washington, DC 20001

TERRARIZINO, ANNA
Phone TTY
202 Lexington Avenue
Hackensack, NJ 07601

THOMAS, CHERYL
Director
Communication Center for the Deaf
4001 Fitzhugh Avenue
Richmond, VA 23230

THORMAN, BEVERLY A.
Staff Manager
AT&T
201 3rd Street, Room 1150
San Francisco, CA 94103

THORSON, JOYCE
Customer Service
HARC Mercantile, Ltd.
HAC of America
P.O. Box 3055
Kalamazoo, MI 49003

TINGLEY, JUDY
Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719

TOBIAS, JIM
Bellcore
445 South Street
Morristown, NJ 07960

TREMAINE, KENNETH
Media/AV Director
Lexington School for the Deaf
30th Avenue & 75th Street
Jackson Heights, NY 11372

TRIANTAFELL, ELENI
Student
Gallaudet University
Washington, DC 20002

TSENG, IRENE
Assistant Professor
Department of Mathematics & Computer Science
Gallaudet University
Washington, DC 20002

TURNER, JAYNE
Ultratec, Inc.
6442 Normandy Lane
Madison, WI 53719

ULLRICH, DAN
5835 Banning Place
Burke, VA 22015

VALISH, MARVIN J.
Board Member--Chairperson
Washington Area Group for the
Hard of Hearing, Inc.
2729 Washington Avenue
Chevy Chase, MD 20815

VERLINDE, RUTH
Captioning Coordinator
National Technical Institute for the Deaf
One Lomb Memorial Drive
Rochester, NY 14623-0887

VIRVAN, BARBARA
Research Associate
Technology Assessment Program
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

WANDALL, FRANKIE N.
103 Bailey Road
Yorktown, VA 23692

WEINER, FRED S.
Special Assistant to the Executive Director
National Association of the Deaf
814 Thayer Avenue
Silver Spring, MD 20910

WEINSTOCK, ROBERT
Coordinator, Information Services
National Information Center on Deafness
Gallaudet University
Washington, DC 20002

WEITZ, STEPHAN A.
President
Sawtech Communications Inc.
70-50 Austin Street
Forest Hills, NY 11375

WELLER, DAVID
Bellcore
445 South Street
Morristown, NJ

WELLS, VERA F.
Director
Audience Services
NBC
30 Rockefeller Plaza--Room 2555
New York, NY 10112

WESTLAND, JOAN
Executive Director
Canadian Council on Deafness
116 Lisgar
Ottawa, Ontario
CANADA

WHITE, JOHN
Regional Manager
InfoMedia
7700 Leesburg Pike
Falls Church, VA 22043

WHITNEY, JAMES E.
Electrical Engineer
Center for Auditory & Speech Sciences
Gallaudet Research Institute
Gallaudet University
Washington, DC 20002

WIET, RICHARD J.
The Chicago Otology Group
950 York Road
Hinsdale, IL 60521

WILLIAMS, JO
Manager
Audiology Technical Assistance Section
American Speech-Language-Hearing Association
10801 Rockville Pike
Rockville, MD 20852

WILSON, JOHN
Computer Programmer Analyst
HUD
451 Seventh Street, SW
Washington, DC 20410

WISDOM, CAROL
Graphic Designer
Federal Reserve Board
20th and Constitution
Washington, DC 20551

WOLF, JUDITH
Market Development Manager
Stenograph Corporation
7300 Niles Center Road
Skokie, IL 60077

WOOLSEY, JANE
6927 Leameadow
Dallas, TX 75248

YADAV, PRADEEP K.
Research Engineer
Department of Audiology
Gallaudet University
Washington, DC 20002

YEH, JOHN
President
Integrated Microcomputer Systems, Inc.
2 Research Place
Rockville, MD 20850

YEH, FANNY
Product Manager
Integrated Microcomputer Systems, Inc.
2 Research Place
Rockville, MD 20850

ZUBACK, JOHN R.
Technical Specialist
AT&T
3201 Jermantown Road, Room 4-C
Fairfax, VA 22030-2885

Gallaudet University, in Washington, DC, is the world's only liberal arts university for deaf students. In addition to offering on-campus educational programs from the preschool to doctoral levels, Gallaudet is an internationally recognized center for research, program development, and consultation related to deafness and hearing loss. Gallaudet University is an equal opportunity employer/educational institution. Programs and services offered by Gallaudet receive substantial financial support from the U.S. Department of Education.